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UNDER THE BANNER OF COMMUNIST LABOR

The year 1959 has passed, the year of the Twenty-first Congress of the Communist Party of the Soviet Union, a year of legendary accomplishments in labor, of very great success in the development of rocket technique and slackening of tension in the international situation. The remarkable achievements of heroes of the seven-year period will be written in gold letters in the history of the building of communism.

The Seven-year Plan for growth of the national economy has opened up majestic perspectives before Soviet man and has given him new strength in his impetuous drive forward. Made enthusiastic by the historic decisions of the Twenty-first Congress, one of the best collectives of the country, the "Zaporozhstal'" steel works, headed the socialist competition for completion in advance of the plan for 1959, the first year of the seven-year period.

The blast-furnace operators, steel mill hands, and rolling mill operators conducted a decisive struggle with thriftlessness, wastefulness, and negligence of the national welfare, for the lowering of costs of production and for the maximum utilization of working capacities.

Manifesting an authentic communist attitude toward work, the team of the Communist Youth Furnace of steel works No. 1 of the "Elektrostal'" mill, headed by steel mill workers N. Morozov, S. Dubov and A. Sergushin and foremen M. Chekalkin, S. Glazkov, N. Shershavkin, and V. Ushakova, out of patriotic initiative undertook to organize competition in the saving of expensive alloying metals and alloys and to proceed to steel smelting at the lower limits of alloying element concentration. For displaying initiative and attaining success, the entire team of this electrical furnace and each worker individually were awarded the honorary award of the All-Union Central Council of Trade Unions. The Presidium of the Central Committee of the trade union endorsed the valuable initiative of the innovators and circulated information about it to other plants of the country. Steel workers of the "Sibelektrostal'", "Dneprospetsstal'", the Serov, and many other combines answered the call.

During the third quarter alone of last year, the steel workers of one furnace at the "Sibelektrostal'" works saved a total of more than 15,000 rubles worth of ferrous alloys by melting steel at the lowest limit of alloy content.

In the struggle for maximum utilization of working capacities, the metallurgists of the "Zaporozhstal'" plant attained outstanding success by melting 227 thousand tons of steel per open-hearth furnace rated at 185 thousand tons, thus setting a new All-Union and world record. Steelmen P. S. Zalozh, I. A. Moiseenko, N. I. Gubar', and S. T. Shestakov smelted more than 237 thousand tons of steel in their furnace during the year. The annual productivity of the open-hearth furnaces at Zaporozhe surpassed that of similar open-hearth furnaces of Western Europe and the United States of America. Steelmen Zalozh, Moiseenko, Gubar', and Shestakov have assumed the duty of producing 240 thousand tons of steel in 1960.

Our grand purpose, the building of communism, has given the Soviet people an enormous energy, a creativity unprecedented in history, which has flowed out in the concrete form of a massive movement to attain the rank of collectives and shock-workers of communist labor.

The initiators of this movement in the steel industry were steelworker I. Kaela of the "Zaporozhstal'" works; a furnace attendant at the Dzerzhinskii plant, P. Lygun; steelworker N. Buinyi of the "Dneprospetsstal'" electric furnace plant; steelworkers Ya. Kal'nichenko, Yu. Ploskonenko, T. Obraztsov and Yu. Zashlyapin of the Nizhne-Tagil' combine; and many others. They entered the ranks of scouts of the future and carried along with them tens of thousands of workers, engineers, and technicians. Now we have not only teams but entire plants of communist labor.

In the steel plants and iron-ore mines of the Kemerovo district 40,000 men decided to live and work communistically; in the Sverdlovsk district over 17,000 men.

The team of communist labor of rolling-mill operator A. N. Buvalko of furnace No. 1 of the Taganrog pipe-welding plant exceeded the seven-year plan quota for last year by 16.9% and produced several thousand tons of pipe above quata, saving 102.7 tons of metal and 775 tons of fuel.

A brillant instance of constructive service to the building of communism was the generous example of assistant drawing-mill operator V. I. Gaganova, Hero of Communist Labor.

The best metallurgists and steel workers of the "Dneprospetsstal'" plant, D. Galushko and F. Chistyakov, blast-furnace master M. Voloshin and M. Seregin, leader of the picklers of the cold rolling mill of the "Zaporozhstal'" plant and the well-known steelworker of the "Red October", Hero of Socialist Labor A. Serkov, were the first in the country to follow her example, as were the master of the open-hearth furnace at the Dzerzhinskii plant, V. Golubitskii, the pipe-cutting foreman at the

Taganrog foundry, V. Gaiduk and many others. Like V. Gaganova they also moved lagging collectives to make them leaders.

Love for our native country, the inclination to raise the laggards to the level of the outstanding and to secure a general productive elevation and improvement in the welfare of the Soviet nation, all this governed these people.

On the basis of the working and political lift evoked by the historic decisions of the Twenty-first Congress of the Party and the June Plenum of the Central Committee of the Communist Party of the Soviet Union, the plants of the ferrous metallurgical industry fulfilled the 1959 quota ahead of time and gave the country hundreds of thousands of tons of pig iron, steel and rolled iron. In 1959, 43.0 million tons of pig iron and 59.9 million tons of steel were smelted and 47.0 million tons of rolled iron were produced. Pig iron and steel smelting in the USSR in 1959 was greater than in England, France and West Germany taken together.

The collective of the "Zaporozhstal'" handled with honor the obligations it had assumed – contributed additional thousands of tons of pig iron, steel, rolled iron, agglomerate and tin plate and saved more than 20 million rubles as a result of introducing efficient suggestions and devices into production. In his welcoming address the Chairman of the Council of Ministers of the USSR, comrade N. S. Khrushchev heartily congratulated the collective for their great productive victory and in the name of the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the USSR wished them new success in their future work.

No less success was attained by the collective of Nizhne-Tagil' metallurgical combine, which filled its 1959 quota in advance and produced tens of thousands of tons of ore, agglomerate, coke, pig iron, steel and rolled iron above the quota. In spite of the success attained in ferrous metallurgy, however, there is still a shortage of pig iron, steel and rolled iron (especially pipe) for complete satisfaction of the ever-increasing requirements of the national economy.

The year 1960 is a significant one. Fulfillment of this year's quota ahead of time will lay the basis for completion of the Seven-year Plan ahead of schedule.

The success attained in fulfilling the plan for the first year of the Seven-year Plan and the additional productive reserves disclosed in the course of competition have enabled us to provide for higher assignments in the plan for 1960 than were contemplated for that year in the Seven-year Plan. In 1960, the metallurgical industry should smelt 47.07 million tons of pig iron, 64.92 million tons of steel, and produce 50.25 million tons of rolled iron and 5.85 million tons of steel pipe. The mere increase in steel melting in 1960 will exceed the entire annual production of steel in Russia in 1913.

The serious production problems placed before metallurgists require a still higher level of work of trade union organizations in mobilizing workers, engineers, technicians and those working on the discovery and introduction of all productive reserves, on economy of working time, raw materials, other materials, power, light metals, on the extensive introduction of new techniques, complex mechanization and the automation of productive processes.

In response to the appeal of Comrade Khrushchev at the December Plenum of the Communist Party's Central Committee for additional reserves of metal for agriculture the Magnitogorsk metallurgical collectives called upon all the steel workers in the country to join in competition for above-quota metal for the needs of agriculture and assumed responsibility for producing in 1960, 100 thousand tons of ore, 20 thousand tons of coke, 100 thousand tons of agglomerate, 20 thousand tons of pig iron, 104 thousand tons of steel and 25 thousand tons of rolled iron above the quota.

The appeal of the Magnitogorsk collectives was taken up with enthusiasm by the steel workers of the South. P. Makhota, steel worker of the Petrovskii factory, Hero of Communist Labor, deputy to the Supreme Council of the Ukrainian SSR and a leader of a team of communist labor, responded with an appeal to all metallurgical workers of the Ukraine in which he gave them the duty of increasing blast-furnace runs in 1960 to 550 smeltings instead of 480, as it was last year, to reduce scrap by 20% as compared with last year and to produce 500 thousand tons of steel above the quota.

Great tasks face the trade union organizations of the steel works in 1960. It is necessary to improve in every way organizational work on the further development of competition to be called collectives and shock-workers of communist labor and to adopt every measure in order to attract into this patriotic movement an absolute majority of workers, engineers and technicians.

It is necessary to recall constantly that the increase in production of ferrous metals in 1960 should be assured on the basis of improved utilization of existing metallurgical capacity introduced last year.

In connection with this an especially important significance is attached to the organization distributing information about the work experience of outstanding collectives which have sought the best indexes of exploitation of the most important metallurgical aggregates.

It is necessary to publicize the experience of the outstanding collectives and of individual workers who are innovators in production. Practice has shown that the best form of publicizing of outstanding experience is the transfer of advanced working methods and technology directly to the place of work.

In fulfilling the historic decisions of the June Plenum of the Central Committee of the Soviet Union's Com-

munist Party the collectives of metallurgical enterprises have planned a large program of mechanization and automation of productive processes and modernization of existing equipment. The commissions for contributions to technical progress created in the enterprises have already begun to work. In the very first day of their existence they especially need the help and support of the trade union organizations. It is necessary that the trade union committees create all the conditions for the successful work of these committees and cooperate fully with them in fulfilling the measures planned.

A large contribution has been made to the success attained in metallurgy by inventors and innovators, who form an army of many thousands in the forefront of the struggle for technical progress, the introduction of new techniques and progressive technology into production, for the maximum utilization of all productive reserves.

Metallurgists did good work in 1959. A good beginning has been made in 1960. The remarkable affairs of the leading collectives which have begun a struggle in the production of above-quota metal for the needs of agricultural machinery building are already known to the entire country. This testifies once more that the Soviet metallurgists are honorably fulfilling the assignment of the Party and completely assuring ferrous metals to the national economy.

* * *

THE CORRECT USE OF GOSBANK CREDITS TO INTRODUCE NEW METHODS INTO THE STEEL INDUSTRY

V. A. Markov

Finance Research Institute of the Ministry of Finance of the USSR

Translated from Metallurg, No. 2, pp. 4-5
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The solutions of the Twenty-first Conference and the June Plenum of the Central Committee of the Communist Party of the Soviet Union envisage the widespread introduction of measures for improving the technical level of production in all branches of industry. This will be based on further development of electrification, complex mechanization and automation, the introduction of newest high-productivity equipment and advanced techniques. These measures will result in an increase in labor productivity and a reduction in production costs.

Further improvement in production will be made possible to a large extent by Gosbank credits. As in the case of budget financing, credit is used to satisfy additional requirements for technical equipment in undertakings which are not catered to by the capital investment plan and for work which is not connected with new construction and complete redesigning of the plant.

Gosbank credits are given to plants in the steel industry for periods of up to three years from the day the first loan is given, providing there is total recovery of the expenses and repayment of the loan during this period from savings made at the plant due to increase in labor productivity, reduction in costs and improvement in the quality of production.

Gosbank credits are used to acquire, manufacture and assemble equipment, to replace individual machines or their parts, organize automation and flow lines, introduce complex mechanization, acquire new, and improve existing transport facilities and for other purposes.

Between 1955 and 1957, the steel industry received 346 million rubles in credits. During this time more than a thousand measures were put into effect to improve production, thus giving an extra 163.3 million rubles production and savings of 146 million rubles. In 1958 the steel industry received more than 200 million rubles in credits; 600 measures were introduced as a result of which there was an extra 123.8 million rubles production and savings of 128.5 million rubles.

Some steel plants make extensive use of bank credits for introducing new techniques and mechanizing production. For example, the Zlatoustovsk Steel Plant in 1957 introduced 16 measures for the mechanization of production, having received 1.2 million rubles in credits from the Gosbank. The total savings achieved amounted to 1.4 million rubles.

In 1958 the Dzerzhinskii Plant was given credits for 22 projects and the K. Libknecht Plant was given credits for 11 projects.

Experience has shown that most of the Gosbank loans are used efficiently and help to increase the labor productivity, reduce costs and improve the quality of production.

Many steel plants use bank credits for automating production. For example, the Pervourals new pipe plant, using a 928 thousand ruble loan from Gosbank, completely automated the 140-1 pipe-rolling mill. The annual saving from this was 604 thousand rubles.

Gosbank credits are used to acquire specialized transport equipment to be used in mechanization of loading and unloading work. The Kushvinsk Steel Plant used a Gosbank loan to buy and assemble 3 magnetic bridge cranes on the charge yard, each of 5 tons capacity. This reduced the holdups at the open-hearth furnaces due to unpunctual and insufficient preparation of the charge.

The Verkh-Isetsk Steel Plant used credits to buy equipment for dehydrating fuel oil. The introduction of this equipment reduced the average smelting time by 30 minutes and gave savings in excess of those expected (from April to December 1958) of 440 thousand rubles, which completely covered the costs for the equipment.

The "Serp i Molot" Plant used Gosbank credits to introduce a number of new techniques and to mechanize production: 12 automatic machines were manufactured and assembled to feed bars into centerless grinding machines, one open-hearth furnace and one electrical furnace in the foundry were redesigned, a roll normalization furnace was installed in the sheet-rolling mill, utilizator boilers were installed behind the open-hearth furnaces, etc.

The Gor'kii Steel Plant used 776 thousand rubles of bank credits to install a steam raising system to cool one of the heat treatment furnaces; considerable savings then resulted from the reduction in the cost of steam.

However, despite the obviously favorable results, the role of credit in financing technical improvements is still small. The steel industry is still not making sufficient use of Gosbank credits. In 1957 the proportion used by steel plants in the total amount of credits for introducing new techniques and mechanization of production comprised 4.5%, and during 1958 this figure was 5.5%.

The steel plants controlled by the Moscow Region Council of National Economy are not making sufficient use of Gosbank credits. Of these plants only 7 used credits in 1958, and of these some used very few credits.

There are some serious drawbacks hindering further introduction of new techniques with the aid of bank credits. One of these drawbacks is the unsatisfactory material and technical equipment of these plants, which operates against the introduction of new techniques and in a number of cases causes work to be stopped. For example, the Petrovskii Plant made poor use of credit granted to it in 1958 to install utilizator boilers in the open-hearth furnaces. The work stopped due to the transfer of manpower to other projects and the 700 thousand ruble credit was subject to a penalty. This plant had intended to use bank credit during 1958 for the following measures: to use natural gas instead of coke to fire the lime roasting furnaces; to change 26 slag cars from screw coupling to automatic coupling; etc. The plant did not put a single one of these measures into practice. Due to the late arrival of the armature and equipment, the periods for the final conversion of the furnaces to oxygen operation were put back three times, and the date for installing ejectors for removing ingots from the heat-treatment furnace was put back twice.

The times for carrying out measures at the Dzerzhinskii Plant were not met, since equipment was not supplied in time. The completion of the work on mechanization of cold repairs in the open-hearth furnaces dragged on for 8 months due to the late arrival of equipment from the Nikolaev Foundry Plant.

However, it is not only the suppliers who are to blame for the slow introduction of new methods. Quite often the management does not pay sufficient attention to this important business. Thus, the management of the Chelyabinsk Ferroalloy Plant did not install a conical crusher in time, this equipment being paid for by a loan, although the plant had the necessary material.

When using bank credits, some plants do not realize that new production capacity should only be installed if they can provide raw material, fuel and energy. For example, the Gor'kii Steel Plant used a bank credit to make and install a quenching unit to convert the quenching of saws to the flow method of production. This unit was to mechanize the grinding, polishing and quenching of saws. The savings should have been 215 thousand rubles per year. In actual fact, no such saving was obtained, since the quenching unit was only used to 50% of its capacity due to the lack of cold-rolled steel.

At the present time, funds are granted for construction materials and equipment only for work which is included in the plan of capital investments covered by budget financing. The sums obtained in credit from Gosbank, despite the fact that they can be used for almost all types of capital construction (apart from new construction and total redesigning of plant), are not provided by material resources. This often holds back the introduction of new methods.

An analysis of the use of Gosbank credits shows that due to lack of provision for work for which the credits have been issued, the planned periods for introducing the measures are sometimes not kept. This leads to freezing of the bank resources and to their inefficient use.

For work which is paid for by Gosbank credits, it is essential to allocate construction materials and equipment on the orders of the steel plants. This will permit punctual introduction of the new measures and more

effective use of the credits. Allocating material stocks for technological improvements in production increases the responsibility of managers for the punctual carrying out of these measures.

The existing credit rules forbid the granting of loans to efficiently operating plants if their debts are overdue to the Gosbank on previous loans for introducing new techniques. It is clear that this type of credit is undesirable in cases where the debt is due to the late delivery of equipment and materials.

It would be better to give credits to plants in cases of overdue debts on loans which have been granted for introducing new methods. If these works are very much overdue in their debts, then it is necessary to apply the normal credit sanctions to them.

There should be an increase in the range of loans made by Gosbank for measures which will not give additional benefits for the plants immediately concerned in introducing the new method, where the benefit is felt by the consumers, and also for technical measures which help the workers and increase the quality of production. In these cases the credits can be cancelled out by means of depreciation deductions.

The extent to which transitional debts on credits are written off for new methods should be improved by profits being above the expected level.

Improving the financing system by using bank credits to introduce new methods, mechanization and improving production techniques will help steel plants to to develop tremendous internal reserves which will help to fulfill the tasks presented by the Twenty-first Conference and the June Plenum of the Central Committee of the Communist Party of the Soviet Union for the Further Technical Development of Production.

ROASTING FLUXED SINTER WITH THE ADDITION OF DOLOMITIZED LIMESTONE TO THE SINTER CHARGE

B. N. Starshinov, V. P. Onoprienko, D. P. Burdyukov, V. I. Khalimonova, and L. I. Sergienko

Translated from Metallurg, No. 2, pp. 6-7, February, 1960

In 1958 at the Krivoi Rog Steel Plant two blast furnaces changed over to the smelting of Bessemer iron, which is best smelted with magnesia slags, giving increased and constant heating of the blast-furnace hearth. With reduced content of manganese (1.0-1.4%) in this case it is possible to reduce the amount of sulfur in the iron.

At the end of 1957 the basicity of the sinter at the plant was increased to 0.9-1.0 and in the second half of 1958 to 1.0-1.1. With the sinter basicity at 0.95 and the blast-furnace slag at 1.15-1.20, the consumption of raw limestone was 150 kg per ton of iron. By replacing the raw limestone with dolomitized limestone, it was possible to increase the MgO content in the slag by a about 2%. Furthermore, unavoidable corrections to the composition of the slag and the consumption of the limestone would cause in this case considerable fluctuation in the MgO content in the slag, which would have an unfavorable effect on the operation of the blast furnaces.

It will therefore be better to replace only a part of the limestone in the sinter charge by dolomitized limestone, which will provide a more uniform distribution of MgO in the charge and a more complete transfer of MgO into the primary blast-furnace slags.

Tests were carried out in 1958 on the roasting of fluxed sinter with the addition of dolomitized limestone in the sinter charge. The results are given in the Table and in Figs. 1 and 2. Since the content of MgO in the dolomitized limestone varied between wide limits, the sinter was obtained with a different content of MgO for the same addition of limestone to the charge.

With the total replacement of ordinary limestone by dolomitized limestone, the content of MgO in the sinter increased from 0.45 to 2.6-4.4%, depending on the content of MgO in the limestone.

Increasing the MgO content in the charge had a noticeable effect on the roasting process. With up to 1.3% MgO in the sinter, the vertical rate of roasting increased, but further increase in the MgO content led to a reduction in the rate of roasting and, consequently, in the output of the sintering machine. With a content of 2.5-3.3% MgO, corresponding to the replacement of 50-75% of ordinary limestone by dolomitized

Results of Roasting Sinter Charge with the Addition of Dolomitized Limestone

Ratio of limestones, %		Content in charge, %		Vacuum, mm, mercury column		Roasting time, min.	Vertical rate of roasting, mm/min	Composition of sinter, %						Content of fractions (mm) after test in drum, %		
Dolomitized	Ordinary	Carbon	Moisture	Initial	Final			Fe	FeO	SiO_2	CaO	MgO	$\frac{CaO+MgO}{SiO_2}$	+12	12-5	-5
0	100	4.19	7.9	435	280	16.2	15.5	47.8	11.8	16.2	14.3	0.45	0.91	16.9	60.7	22.4
15	85	4.26	6.35	430	290	14.4	17.4	48.4	13.0	15.3	12.8	0.84	0.89	21.4	57.4	21.2
25	75	4.28	5.7	440	300	15.0	16.6	47.5	12.2	15.8	13.0	1.53	0.92	25.3	52.5	22.2
25	75	4.14	6.9	450	300	14.7	17.0	48.9	8.9	14.9	12.5	1.41	0.93	16.7	61.7	21.6
35	65	3.57	6.5	470	300	13.3	18.9	48.3	13.4	14.9	12.9	1.25	0.93	20.8	56.2	23.0
50	50	3.46	7.0	440	310	14.0	17.9	50.0	12.1	14.2	11.4	2.33	0.96	14.1	63.6	22.3
50	50	4.18	5.4	480	290	16.3	15.3	48.6	8.9	14.7	11.1	2.31	0.91	17.1	57.3	25.6
75	25	4.83	6.1	480	310	17.7	14.2	47.1	12.6	15.5	11.0	3.10	0.91	20.6	53.7	25.7
75	25	4.14	6.9	450	300	15.0	16.7	48.6	8.6	15.2	10.5	3.17	0.89	34.3	42.1	23.6
100	0	4.49	6.4	470	310	18.0	13.9	46.9	11.7	16.2	10.0	4.36	0.88	27.5	48.0	24.5
100	0	4.14	6.9	420	310	14.3	17.5	50.4	8.9	14.3	9.2	3.58	0.89	17.5	56.7	25.8

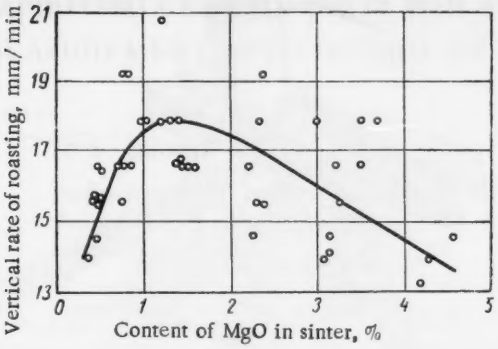

Fig. 1. The effect of MgO on the rate of roasting of the sinter charge.

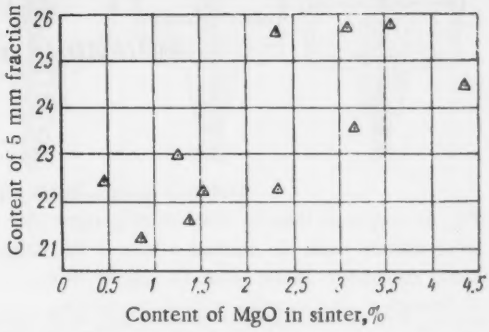

Fig. 2. Content of 5 mm fraction in the sinter after testing in the drum.

limestone, the vertical rate of roasting was the same as in the roasting of a charge with ordinary limestone. Adding dolomitized limestone to the sinter charge in amounts of up to 50% of the total consumption of flux does not therefore reduce the output of the sinter machine. The carbon content in the charge should then be kept between 3.5-4.1%. With further increase in the carbon content in the charge to 4.2-4.8%, the vertical rate of roasting was reduced.

The optimum moisture content, corresponding to the greatest vertical rate of roasting is about 6.5% when all other conditions are equal.

Increasing the MgO content in the sinter to 2.0-2.5% with a ratio of ordinary to dolomitized limestone in the charge of 1:1 had practically no effect on the strength of the sinter. Further increase in the content of MgO led to a sharp reduction in the strength of the sinter.

Consequently, the content of MgO in the sinter is best increased to 2.0-2.5%.

When the consumption of sinter [basicity 0.90-0.95 with regard to $(CaO + MgO)/SiO_2$] is 1.80-1.85 ton/ton of iron and a content in it of 2.0-2.5% MgO, in the blast-furnace slag there is 5.5-6.5% MgO, which is perfectly satisfactory for smelting low-sulfur iron (with 100% sinter in the charge). A constant content of MgO in the sinter must be provided by averaging the dolomitized limestone in the ore yard and limiting the range of fluctuations in MgO in the supplied limestone to a value not greater than ±2%.

* * *

DESULFURIZATION OF IRON OUTSIDE THE BLAST FURNACE

L. Ya. Shparber

Magnitogorsk Metallurgical Combine

Translated from Metallurg, No. 2, pp. 8-9, February, 1960

The problem of producing iron with a low sulfur content is a very serious one in steelmaking.

Many methods have been suggested for desulfurizing iron outside the blast furnace. One of them, used at the Magnitogorsk Metallurgical Combine,* is described in the present article.

In 1958, the average sulfur content in iron smelted in the Magnitogorsk Blast-Furnace Department was 0.031%; however in some tappings it was much higher. The designer of the blast-furnace department was faced with the problem of designing an apparatus for desulfur-

*Those taking part in the work were Yu. P. Volkov, P. P. Mishin, L. Ya. Shparber, V. A. Shastin, N. M. Korchkov, A. G. Toporkov, A. S. Bakshinov, A. I. Dorman, V. I. Mironov, I. M. Ryabov, N. Ya. Mazur, I. A. Grigor'ev. Advice was given by N. L. Gol'dshtein.

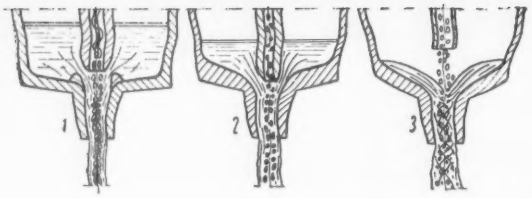

Fig. 1. Types of feed for desulfurizing agent into the intermediate bath: 1) through a hole in the stopper by worm conveyer; 2) the same, by gravity flow; 3) through a pipe into the hole of the nozzle.

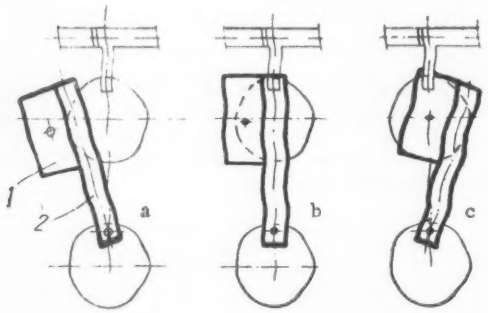

Fig. 2. Positions of 3-way rotating trough: a) tapping without desulfurization; b) during movement of the ladles along the first track; c) tapping with desulfurization; 1) bath for desulfurization; 2) trough.

izing the iron outside the blast furnace. This method had to be used both in the general production stream *and for desulfurization of individual tappings or ladles* of iron.

The apparatus can be installed under one of the lips of the hearth trench; in this case all the iron entering the ladle can be desulfurized.

The desulfurizing agent is added to the metal flowing from the intermediate bath, the addition being either forced or by gravity flow (Fig. 1).

The materials used as the desulfurizing agent were wastes of roasted lime and roasted dolomite. When using lime, the degree of desulfurization varied from *experiment to experiment over rather wide limits. The* average degree of desulfurization was 28.6% with a con*sumption of 1.42% lime in relation to the weight of the* iron. When desulfurizing with fine dolomite, the average degree of desulfurization was 39.6% with a dolomite consumption of 2.5% of the weight of iron.

In the desulfurization other more active desulfurizing agents can be used as well as lime and roasted dolomite.

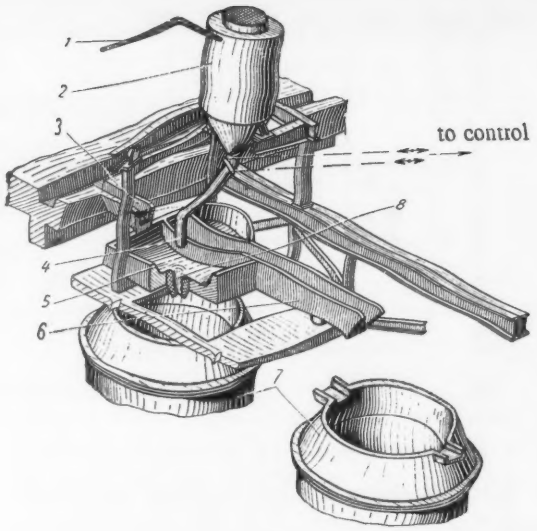

Fig. 3. Industrial apparatus for desulfurizing iron: 1) pipe for pneumatic feed of desulfurizer; 2) hopper; 3) fixed lip of iron trough; 4) pipe for feeding desulfurizer into bath; 5) bath; 6) rotating trough; 7) ladles; 8) nozzle.

The authors of the project have allowed for the possibility of desulfurizing all the iron tapped from the furnace and also individual batches under the supervision of the foremen. For this purpose a 3-way rotating trough was used, occupying 3 positions during the tap*ping (Fig. 2):*

a) Iron from the fixed lip enters the ladle without *desulfurization;*

b) during the movement of the ladles along the first track, the iron passes along the trough into the ladle standing on the second track, without desulfurization;

c) the iron passes through the intermediate bath for desulfurization into a ladle standing on the first track.

The apparatus for desulfurization is shown in Fig. 3. It can be included in the over-all flow line for the shop. This naturally requires careful organization of the whole *process. The desulfurizing agent must be fed into the* hopper pneumatically.

The apparatus described in this article can easily be automated.

About 10,000 tons of iron have been processed by the method suggested at the Magnitogorsk Metallurgical Combine. The results of the work have shown the complete suitability of the method.

IMPROVING CERTAIN UNITS FOR AUTOMATIC MEASUREMENT AND CONTROL OF BLAST FURNACES

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Deputy Head of the Instrument Shop of the Nizhne-Tagilsk Metallurgical Combine

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February, 1960

The blast furnaces of the Nizhne-Tagilsk Metallurgical Combine work with increased gas pressure under the throat with high temperature of the hot blast and constant moisture content. The furnaces are equipped with modern measuring apparatus which indicates sufficient accuracy the thermal state and the state of operation of the furnace and makes it possible to take the necessary steps to prevent deviations from the normal conditions. Furthermore, the furnaces have automatic devices to control the temperature of the air heaters, the temperature of the hot blast, the moisture of the blast, pressure of the gas under the throat and the pressure of the pure gas fed to the air heaters.

Efficient working of the measuring and control apparatus assists the engineers of the combine in achieving good quality and economic operation. In order to improve the instruments and the automatic regulators certain units for measuring individual features and arrangments for automatic control were redesigned and improved. This redesigning took into account the requests of the operating personnel.

Measuring the Temperature of the Hot Blast. The temperature of the hot blast at the Nizhne-Tagilsk Metallurgical Combine is maintained at 850-900° and is measured by a hermetically sealed inertialess chromel-alumel thermocouple (Fig. 1). This design gives a more durable thermocouple and increases its sensitivity.

The thermocouple can be replaced without removing the blast. For this purpose, it is necessary to open a cock on a pipe bringing compressed air at a pressure of 3-5 atm to the body, which can shut off the hot blast with a pressure of 2 atm.

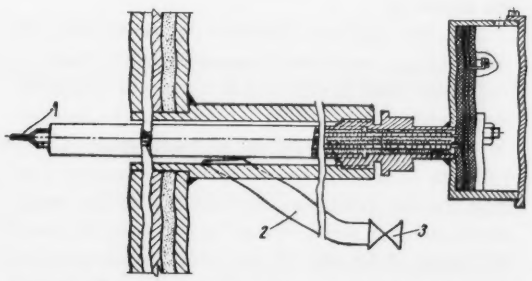

Fig. 1. Thermocouple for measuring the temperature of the hot blast: 1) working junction of thermocouple; 2) pipe for delivering compressed air; 3) cock.

The thermocouple is made up in the following way. The thermoelectrodes, insulated with porcelain beads, are placed in a metal pipe of half-inch diameter, one end of which is open and the other having the head screwed onto it. The whole of the space between the walls of the tube and the thermoelectrodes is filled by means of a special worm feeder by a water-diluted slurry-like mixture of sovelit and cement in 1:1 proportions by volume. The bare working junction of the thermocouple extends 15-20 mm from the tube. Where they bend in the head of the thermocouple, the thermoelectrodes are wound with asbestos cord and packed with asbestos lining.

The assembled thermocouple is put in a drying cupboard at 120-130° for 4-6 days. The resistance between the thermoelectrodes and the armature of the thermocouple in the cold state should be not less than 0.5 meg.

Measuring the Temperature of the Peripheral Gases. The thermocouples for measuring the temperature of the peripheral gases under the protective sectors are installed at six to eight points along the periphery of the furnace. For the normal state of the profile and uniform distribution of the gas stream along the periphery of the furnace, the difference in the thermocouple readings should not exceed 30-50°C.

The limiting value of the temperature of the peripheral gases is determined by the specific consumption of the coke and the degree of development of the peripheral stream of gases. The thermocouple readings are used to correct the operation of the rotating charge distributor. Correct operation of the thermocouples is therefore very important.

Previously, soot penetrated into the tubes containing the thermocouples, as a result of which the thermoelectrodes rapidly carburized and their characteristics changed. They therefore had to be changed every 10-12 days. To increase the life of the thermoelectrodes, a device was developed consisting of a motor-time relay MRV-26 and a solenoid valve SK-3. Every two hours the motor-time relay switches on the solenoid valve and compressed air enters the housings of all thermocouples and blows out the soot. The blowing

continues for 10 sec. This trebled the life of the thermoelectrodes.

The Temperature under the Crown of the Air Heaters. This is measured by platinum-rhodium-platinum thermocouples, enclosed in special hermetically sealed containers and installed at the crown of the air heater in such a way that the working end of the thermocouple projects 50 mm from the lining (Fig. 2). With the correct design of the thermocouple, the temperature can be reliably determined within the limits 1150-1200°.

Owing to the sensitivity of porcelain to sharp changes in temperature, the tube was put in a special protective tube, thus considerably increasing the life of the thermocouples.

Controlling the Compensating Valve for the Operation of the Small and Large Bells. In recent years, due to the increase in the amount of hot sinter in the charge and increase in the gas pressure under the throat, the conditions of operation of the pouring devices have become very complicated. To ensure normal operation of the pouring apparatus, the blast furnaces have been equipped with two SRD pressure difference indicators,

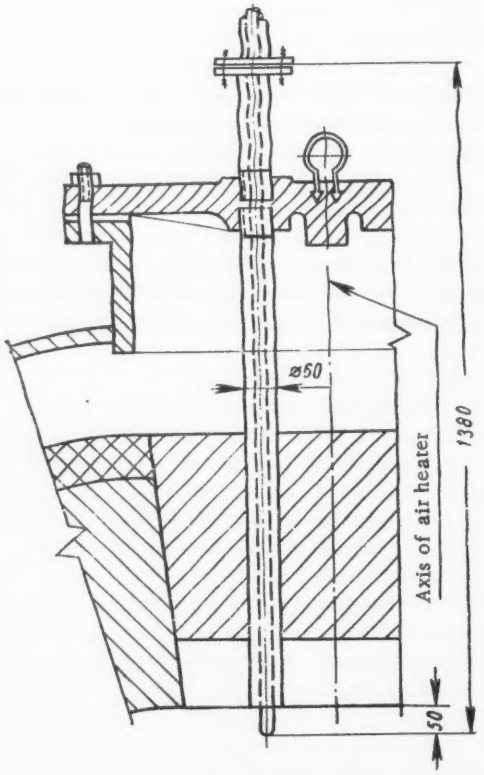

Fig. 2. Arrangement of thermocouple for measuring the temperature under the crown of the air heater.

connected in series with the operating system for the small and large bells.

Normally, the compensating valves are closed. The space between the bells is then isolated from the atmosphere and from the furnace and there is a positive pressure in it due to its being fed by steam. At the start of the ascent of the next skip, an impulse is sent from the magnetic station to open the compensating valve of the small bell. When it is fully opened and the pressure in the space between the bells is reduced to 1200 mm water gauge, the automatic indicators showing the pressure difference in the small bell close the contacts operating the small bell. Only after this is the motor for the bell switched on.

At the start of opening of the small bell, the track switch-off for the bell winch gives an impulse for closing the compensating valve of the small bell and it closes, preventing air being drawn in to the space between the bells, which can occur during simultaneous opening of the small bell and its compensating valve. If, according to the operating loading program, the large bell should be lowered, then at the moment of complete opening of the small bell, an order is recorded at the magnetic station to operate the large bell. After closing the small bell, the valves of the large bell open, and the space between the bells is filled with semipure gas from the high-pressure scrubber. When the pressure drop between the furnace and the space between the bells becomes less than 800 mm water gauge, the pressure difference indicators of the large bell close the contacts, operating the large bell. At the start of its descent, the track switch-off for the bell winch gives an impulse for opening the compensating valves of the large bell, to prevent blast-furnace gas from the furnace entering the scrubber.

Automatic Control of Gas Pressure Under the Throat. In the plans of the Central Planning and Design Office, the pressure of the blast-furnace gas is provided for by the proportional-speed hydraulic floating controller. Allowance was not made for the fact that the throttle group is in the open air and, in the climate of the Urals during the winter, the oil entering the command mechanisms will freeze, thus reducing the sensitivity of the the regulator.

At the Combine, electrical regulators have been made using a proportional-speed hydraulic floating controller insert IR-130 and an electrical command mechanism of the type IMT-100/120. The pressure detector is a floating system with a rheostat. The impulse for controlling and recording the pressure is taken from the dust collector; the selection device works reliably and very rarely chokes up. At first, the operational circuits of the electric regulators worked with alternating current using an ÉP-41/33 intermediate relay. However, since the design of the relay was not calculated for a large number of switchings, it often failed

and the regulators worked unreliably. The operating circuits were therefore converted to direct current using reliable KP-1 constant current contacts.

The coils of the contactors are fed by direct current from a VS-67 selenium rectifier, operating on a single half-period circuit with a capacitor connected in parallel to smooth out the pulsations of the current.

Apart from automatic control, the arrangement includes remote control of the command mechanism and also an indication of the closing of the control gate valve. The use of a direct current starting apparatus reduced the costs on servicing the regulators and improved their reliability.

The Measurement and Automatic Control of the Blast Humidity. In the plan, a sample of air was to be taken to check the moisture from the air pipe of the cold blast. However, as shown by experience under winter conditions in the Urals, with efficiently insulated impulse pipes, the temperature of the air entering the moisture detector was less than the permissible value (40-50°C). It was therefore decided to take the air sample from the hot blast pipe after the air heaters. In this way, it was not only possible to improve the accuracy in determining the moisture, but also to check the working order of the water cooling armature on the air heaters.

The absolute humidity of the air is measured by a psychrometric method, based on the reduction in temperature of the surface of a thermometer moistened with water, due to the loss of heat in evaporation of the water. The difference in temperatures between the dry and wet thermometers and also the absolute humidity are measured by an automatic electronic EMPVA-120 ac bridge.

The air, with the dust removed in filters and cooled to a temperature of 40-50°C, enters the diffuser in which there are two low-inertia copper resitance thermometers, one of which is dry and the other damp.

Both thermometers are connected to an electronic bridge with a rheostat pickup, which works in conjunction with an IR-130 proportional-speed hydraulic floating controller. When the air humidity deviates from the given value, the floating controller switches on the IM-2/120 electrical command mechanism, moving a regulating valve and correcting the humidity by changing the supply of steam to the air pipe of the cold blast.

Most of the moisture (in the form of condensate) is introduced into the blast in the intake of the turboblowers. The average hourly consumption of condensate is 2-3 tons/hr.

To give a constant check on the working of the automatic psychrometer, there is a second stationary pickup with alcohol or mercury thermometers. From the difference in temperatures of these thermometers, nomograms can be used to determine the absolute humidity and compare it with that given by the self-recording psychrometer.

Other operations in the blast-furnace department of the Combine have also been automated. Thus, automation has been introduced into the collection, weighing and loading of the charge into the blast furnace. At two of the furnaces the control of the scale cars has been automated using remote control and a computer device. At two of the furnaces, the thermal system of the air heaters has been automated.

In cooperation with specialized organizations and scientific research institutes, the Combine has recently developed a plan for setting up complex control of blast-furnace operation using computers.

* * *

SINGLE-LIP POURING OF IRON

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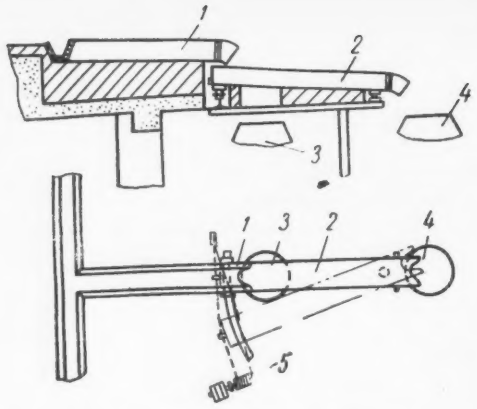
February, 1960

Up to the present time, iron has been poured into the ladle through five lips (for the number of ladles). This type of pouring has not been completely satisfactory due to the large lengths of the iron troughs, the increased volume of hearth work, and the considerable consumption of dressing materials. Furthermore, after each tapping, a large amount of iron was lost in the troughs in the form of scrap.

A new method for pouring iron has been developed and introduced by the following engineers at the



Pouring iron through one lip: 1) stationary trough; 2) rotating trough; 3) ladle on the first track; 4) ladle on the second track; 5) electrical winch.

Magnitogorsk Metallurgical Combine: I. I. Morev, N. I. Savichev, N. G. Gubenko, A. I. Khabarova, N. S. Krivolapov, V. M. Zudin, and L. Ya. Shparber.

The pouring device consists of a platform with a movable trough, which can be rotated by an electrical winch. So that the trough can move freely, its free end is placed on rollers which move along metal guides. The diagram shows the layout of a mechanized pouring device.

The ladles to be used in the pouring are placed on two parallel sets of rails. At the start of pouring, the first ladle standing on the first track is placed under the lip of the stationary trough. Iron from the furnace passes along the stationary trough into the ladle standing on the first track. When the ladle is filled with iron, the rotating trough comes under the lip of the stationary trough and the iron enters the ladle standing on the second track. During this time the first ladle moves on and a second ladle is placed on the axis of the stationary trough and the process is then repeated.

Introducing this new method has provided 70-80% reductions in the length of the troughs in the foundry, has reduced the consumption of dressing materials and considerably reduced the losses of iron in scrap. The total savings in the Magnitogorsk Metallurgical Combine alone were 1 million rubles per year.

Furthermore, the use of a rotating trough provides favorable conditions for mechanization and automation of the work on such difficult sections as the hearth and the foundry of the blast furnace.

IMPROVEMENT OF THE PRODUCTION TECHNIQUE FOR STEEL 10G2SD (MK)

V. M. Bednyakov, M. F. Lepin and G. A. Chikalenko

Zhdanovsk Heavy Machine Engineering Factory
Translated from Metallurg, No. 2, pp. 13-16, February, 1960

In the manufacture of high-pressure petroleum gas pipelines and in the preparation of railroad tank cars for the transportation of compressed gases, steel MK (in accordance with GOST 5058-57 10G2SD) is widely used. The technique for obtaining this steel was developed in the factory named after Il'ich. The steel has the following composition, %.

C	Mn	Si	Cu
less than 0.12	1.30-1.65	0.8-1.10	0.15-0.30

S	P	Cr	Ni
less than 0.040	less than 0.040	less than 0.30	less than 0.30

Because of the low carbon content of the steel, silicomanganese is used to alloy it with manganese, which is added during the preliminary deoxidation of the metal in the furnace. At this time, the steel contained 0.07-0.09% C and 0.20-0.35% Mn; thus, the time the metal was held in the furnace from the introduction of the silicomanganese until pouring the metal was 10-15 min. For the final deoxidation, and to alloy the steel with silicon, 75% ferrosilicon was added in the ladle, as well as aluminum (600-800 g/ton) and ferrotitanium (2 kg/ton of liquid steel).

In this method of alloying, the manganese loss was large and the consumption of silicomanganese stood at 23.3 kg/ton of the finished ingots. To guarantee the minimum manganese content allowed by the technical instruction 5 kg of ferromanganese per ton of steel were expended in the period of the pure boil (0.20%).

At the end of 1954 for the first time a considerable change was made in the technique of alloying grade MK steel; manganese ore was introduced for this purpose during the boil. At the end of refining, additions of ferromanganese were made in the furnace and during pouring additions of silicomanganese as well as 75% ferrosilicon were made in the ladle. This made it possible to reduce the consumption of silicomanganese by 8 kg per ton, at the same time increasing the consumption of ferromanganese by 2-3 kg per ton of finished steel. The change in technique had no effect on the duration of the boil or on deoxidation.

In order to improve the melting and alloying techniques for grade MK steel with the aim of further economy in ferroalloys, since July 1958 our factory has gone over to pouring melts at boil; that is, the deoxidation and alloying of the steel with manganese and silicon are entirely carried out in the ladle.

Grade MK steel is melted in single-spout basic open-hearth furnaces with Dinas (silica) roofs. The furnaces are fired by oil, atomized by air under a pressure of 5-5.5 atm. The sulfur content of the oil does not exceed 0.5%, and the moisture content is not greater than 5.0%.

To estimate the suitability of the particular method of alloying grade MK steel, two groups of melts were prepared. These melts were made consecutively under the same conditions. In each group 45 melts were made. The charge consisted of solid pig-iron (40-45%), grade MK steel scrap (35-40%) and plain carbon steel scrap (15-25%); 1.0-1.5 tons of iron ore and 6-10% limestone were introduced during charging. Before the metallic part of the slag melted down completely, the slag was partially removed.

In general iron ore was added to the adequately heated metal at melt down of the charge. In this period the additional removal of 5-6 tons of slag was carried out. The slag was worked by adding lime, after which manganese ore was added. This made it possible to cut out ferromanganese additions during the course of the melt.

Figures giving the duration of the separate periods in melts made with the ordinary and with the modified technique are shown in Table 1. From this it follows that in the modified technique the total duration of the melt is somewhat shortened because the deoxidation period is omitted.

The manganese content of the finished metal is the same in both groups of melts although the calculated manganese contents differ slightly. This points to a larger manganese loss in melts made with the ordinary technique. This is due to the ferromanganese being introduced into the furnace 10-12 min before pouring the metal. The greater silicon loss is evidently caused by pouring a more oxidized metal, since in this case the

TABLE 1. Chief Details of Smelting Steel 10G2SD with Various Techniques

Detail	Smelting technique		
	ordinary	modified	
		using 75% FeSi	using 45% FeSi
Average length of the melt periods, in hours and min:			
charging	3-50	3-47	3-45
melting	3-25	3-21	3-19
boil	2-53	2-56	2-58
deoxidation	0-09	–	–
total	10-17	10-04	10-02
Composition, % at melt-down:			
C	1.11	1.09	1.15
Mn	0.28	0.31	0.28
before deoxidation (or pouring):			
C	0.08	0.08	0.08
Mn	0.29	0.32	0.31
Consumption of ferroalloys, kg per ton of finished ingot:			
75% FeSi	13.0	12.3	–
45% FeSi	–	–	21.2
FeMn	6.75	3.12	3.20
SiMn (basic weight)	14.2	16.20	16.3
Change in composition in the course of casting (average values), %:			
Mn	+0.08	+0.05	+0.105
Si	−0.104	−0.06	+0.07
P	+0.0068	+0.0033	+0.0038
Composition of finished metal, %:			
calculated Mn*	1.71	1.63	1.59
Si	1.21	1.22	1.20
actual Mn	1.41	1.42	0.40
Si	0.98	0.94	0.93
Loss, %:			
Mn	17.4	12.5	11.9
Si	19.2	23.0	22.5

* In the calculated manganese content, the manganese, introduced either in the furnace or in the ladle during deoxidation with ferromanganese, and the manganese contained in the metal before deoxidation or before pouring from the furnace are taken into account.

partial deoxidation of the metal in the furnace by ferromanganese is omitted.

It should be noted that to prevent secondary reactions between metal and slag, which would lead to an increased manganese and phosphorus content and to a reduced silicon content, 80-100 shovelfuls of lumps 60-100 mm in size of Saranov deposit chromium ore are thrown into the ladle after the removal of the slag from the furnace; because of this a protective layer is formed between the metal and the slag and the activity of the slag is reduced.

A comparison of the data for the consumption of ferroalloys in smelting steel with the two techniques (Table 1) indicates that the consumption of ferromanganese and 75% ferrosilicon in melts made according to the modified technique is reduced by 3.6 kg and 0.7 kg, respectively, whereas the consumption of silicomanganese is increased by 1.7-2.0 kg. With the price of silicomanganese, ferromanganese and 75% ferrosilicon at 1134, 1010 and 1090 rubles per ton respectively, the cost of 1 ton of steel smelted according to the modified technique is reduced by

TABLE 2. Plate Mechanical Properties and Quality

Detail	Smelting technique		
	ordinary	modified	
		using 75% FeSi	using 45% FeSi
Mechanical properties:			
yield strength, kg/ mm²	41.7	41.1	40.7
tensile strength, kg/ mm²	54.8	54.2	54.2
elongation, %	24.8	25.4	25.5
impact resistance, kgm / cm²	7.55	7.4	7.5
Number of plates examined	6765	7890	4829
Preliminary rejection of plates for metallurgical defects:			
number	345	388	517
%	5.10	4.90	10.7
Percentage rejected for:			
scabs	3.18	3.10	7.80
seams	1.83	1.76	2.78
blow-holes	0.015	–	0.02
nometallic inclusions	0.045	0.03	0.08
cracks	0.03	0.01	0.02

$3.6 \times 1.01 \times 1.09 - 2 \times 1.13 = 2$ r. 14 k. because of the economy in ferroalloys.

Grade MK steel is poured into ingot molds to obtain ingots weighing 3.4 tons for sections and weighing 8.4 tons per plate. Plate ingots are rolled down directly to plate 32 mm thick. However, because of the small percentage of plate ingot production in the total production volume of grade MK steel, melts were studied from which section ingots were cast. After removal of surface defects, 4 slabs are prepared from each section ingot, which are rolled to 7 mm thick plate. To conform with the technical specifications in mechanical properties, grade MK steel must fulfil the following requirements:

tensile strength ..... not less than 52 kg/ mm²;
yield point..... not less than 38 kg/ mm²;
percentage elongation on a specimen having a length: diameter ratio of 10:1....not less than 18%;
impact resistance at −20°C after artificial aging (strain not less than 10%, aging 1 hour at 250°C) .....not less than 3 kgm/ cm².

The results of the investigations of the mechanical properties and the quality of the plates indicate that the plates meet the technical specifications in all the details of their mechanical properties (Table 2).

The data of Table 2 also indicate that the preliminary rejection of the plates for defects having a metallurgical origin is practically the same for metal of both groups of melts.

In this way, the modified technique for smelting and alloying grade MK steel made it possible to save about 2.3 kg of ferroalloys per ton of finished ingot, to reduce differences in the chemical composition of the metal during casting and to shorten melt-time by 10-15 min by the omission of the period of deoxidation of the metal in the furnace: The surface quality of the plates and their mechanical property details remain the same.

Figures are also shown in Tables 1 and 2 for melts in which 45% ferrosilicon was used to alloy the steel with silicon (the consumption of it was 20-22 kg per ton of liquid steel). As can be seen from these figures, the length of the separate periods of the melt and the chemical composition of the metal at melt-down and before pouring, as well as the value of the manganese and silicon losses, do not differ from the corresponding figures for ordinary melts.

It follows from the data of Table 1, that with the use of 45% ferrosilicon, the heterogeneity of the steel in manganese and silicon is increased. Moreover, in this case there is a considerable increase in the number of melts in which the ferroalloys do not completely dissolve but partly come to the surface in an upper layer of metal as a crust. This is very undesirable because, in the ingots in the course of casting, the manganese and silicon contents rise sharply because of the dissolution of this crust: This leads to the rejection of ingots or the their regrading to grade "zero" steel because their chemical composition does not conform to GOST requirements.

In the ingots from the last bottom plates the manganese and silicon content is increased by a factor of

two in comparison with the ingots from the first bottom plates. With the use of 75% ferrosilicon the greatest value of the deviation of the manganese content from the GOST requirement on the high side reached 0.10-0.15%; no instances of silicon content deviation were observed.

Moreover it should be noted that in the short working period (about a month) when the factory was using 45% ferrosilicon, a considerable number of ingots (38 ingots weighing 3.4 tons) were regraded as grade "zero" steel and 5 ingots were completely rejected because their managanese and silicon contents considerably exceeded the limits permitted by GOST. In the same time, from the same number of ingots made with the use of 75% ferrosilicon, only 2 ingots were regraded as grade "zero" steel because of increased manganese content (by 0.10-0.13%), and there were no instances of complete rejection.

No appreciable difference in the mechanical properties of plates is noted with the use of 45% ferrosilicon.

Inspection of the quality of plates indicates convincingly that the use of 45% ferrosilicon for alloying grade MK steel with silicon is undesirable because, with this, the incidence of plates with defects having a metallurgical origin is considerably increased.

Scabs and seams form the chief defects in grade MK steel plates. The incidence of plates with these defects increases particularly sharply if the steel is alloyed with 45% ferrosilicon.

Laboratory investigations of samples of grade MK steel with scabs showed that defects in the form of swellings and scabs rolled out from them in the plates are caused by nonmetallic inclusions and gas segregation.

The formation of scabs takes place in the following way. Upon heating the slab for rolling, because of the difference in temperature between interior and surface layers, hydrogen present in solid solution diffuses from the center to the outside. This diffusion gives rise to an increased hydrogen concentration in the surface layers, which leads to the evolution of hydrogen from solid solution at segregations of nometallic inclusions.

In rolling, when the thickness of the layer of metal which is being decreased reaches a certain small value, the pressure of hydrogen rises, because of which swelling of a separate layer occurs.

Ferroalloys, introduced into the ladle in large quantities, can serve as the source of the increased hydrogen content. The gas-saturation of alloys depends essentially on their structure, degree of fragmentation, and consequently also on their cooling conditions. Other things being equal, the hydrogen content of 45% ferrosilicon is approximately 1.5 times greater than that of 75% ferrosilicon.

Ferroalloys are usually preheated in the molds, which, naturally, does not furnish a complete anneal because of the small surface and the short time in the furnace. It is impossible to hold ferroalloys in the furnace for a longer time because of their fusing. Therefore, to anneal them completely special furnaces are necessary.

The saturation of the steel with hydrogen particularly increases on replacing 75% ferrosilicon by 45% ferrosilicon.

Side by side with scabs, a considerable number of the plates underwent preliminary rejection because of seams discovered on cutting the plates. According to the technical specifications on the delivery of plate metal, seams are not permissible in the plates.

The findings indicate that seams discovered on cutting the plate are connected with contamination of the steel by nometallic inclusions.

External examination of specimens with seams indicated that they are distributed for the most part near to the surface of the plate and have the appearance of interrupted streaks from 5 to 100 mm or more long.

Microexamination of the seams by etching showed that in all cases they were connected with the presence of nonmetallic inclusions in the form of aluminates, silicates and oxides. The principal inclusions were aluminates, often being arranged in very massive clusters in the form of drawn out chains.

On the basis of the work on the new technique and from the results of the investigation of the quality of the metal, the following conclusions may be made:

1. The modified deoxidation and alloying technique for grade MK steel makes it possible to shorten the melt-time by 10-15 min, to reduce the consumption of ferroalloys by approximately 2.3 kg per ton of finished ingot, and to reduce somewhat differences in the chemical composition of the metal in the course of casting.

2. The use of 45% ferrosilicon for deoxidizing and alloying grade MK steel is not practicable, since the rejection of plates because of scabs and seams is markedly increased.

3. Scabs and seams are the principal defects in grade MK steel plates. The formation of defects as swellings and scabs rolled out from them in the plates is governed by the diffusion of hydrogen from interior layers of the metal to the surface, and by its concentrating around nometallic inclusions.

4. To reduce the incidence of plates affected by scabs it is necessary to anneal the ferroalloys sufficiently thoroughly in special furnaces.

* * *

IMPROVEMENT IN THE DESULFURIZATION PROCESS IN MELTING HIGH-CARBON TOOL STEELS

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High-carbon tool steels of A grade, with a sulfur content not exceeding 0.020%, are melted in 100-ton basic furnaces with magnesite-chromite roofs, heated with mixed gas (coke-oven gas and blast-furnace gas). Oxygen is used for intensifying combustion.

The charge is made up of a minimum quantity of scrap, turnings, and bales. The hot metal contains 0.040-0.045% S. Limestone has been added to the charge in quantities amounting to 8-9% of the metal portion of the charge.

The recommended steel-plant practice was to effect desulfurization during the boil period. No special attention was paid to the removal of sulfur in the initial heat period (end of melt-down and commencement of working or refining period).

This situation was based on the following desulfurizing conditions:

1) Highest possible slag basicity;
2) Lowest possible ferrous oxide content of the slag;
3) High bath temperature.

Satisfactory desulfurizing conditions (high slag basicity, low FeO content of slag, high metal temperature) are usually realized in the second half of the boil. The steel-plant personnel therefore paid special attention to the technology of the final period of the heat.

In the production of high-grade tool steel, it is not always possible to realize the necessary conditions for successful sulfur removal in the boil period. It is difficult to produce the necessary quantity of highly basic slag of sufficiently uniform composition at the comparatively low tempeatures of the process (1490°-1580°C, according to immersion thermocouple) and limited period of boil (50 min).

Investigations have shown that the distribution coefficient of sulfur between slag and metal begins to increase appreciably only for an FeO content of the slag less than 10-12%. In practice, this cannot be achieved. The mean ferrous oxide content of the slag in the given period varies within the limits of 12-18%. Overheating of the metal cannot be allowed as this would have a detrimental effect on the deoxidation of the steel; the surface of the rolled products would suffer and the furnace lining would be damaged.

The alteration in assignment of heats due to high sulfur content was 25-30% monthly. For this reason, specially selected hot metal with low sulfur content (not exceeding 0.040%) has recently been used for melting high-grade tool steel, so that not more than 0.030-0.035% S was obtained in the metal after melting down. Even in these conditions, the failure to satisfy orders amounted to 22.5% of the total production in October, 1958.

It is well known that the removal of sulfur is more complete the higher the content of free basic oxides, i.e., the higher the basicity of the slag; the lower the ferrous oxide content of the slag; the higher the temperature of the steel; the greater the volume of slag or the greater the frequency of its renewal; the greater the surface of contact of slag and metal or the duration of the reaction between them; the higher the carbon content of the metal. Practice has shown that all these conditions can be realized more readily at the end of the melt-down period and at the commencement of the working period of the heat than in the boil period.

On this basis, new techniques for the desulfurization of the metal have been developed and tried.

The charge is made up of 60% hot metal and 40% metal scrap. Depending on the composition of the scrap and the chemical composition of the hot metal, 11-12% limestone and 2% bauxite of the weight of the metallic portion of the charge is added, thereby ensuring the production of a highly basic, fluid slag with an excess of CaO at the end of melt-down.

The carbon content after melt-down should be 0.6-0.9% higher than the carbon content at the moment of deoxidation.

After the addition of hot metal, the slag is removed in an amount not less than a full slag ladle. At the end of melt-down, due to the limestone in the charge, a highly basic (2.4-3.0) fluid slag is formed with a CaO content higher than 42-45%. If basicity is inadequate, it is permissible to add lime at the end of melt-down in a weight not exceeding 0.5-1.0% of the weight of the metal portion of the charge. If the slag is thick and of low activity, the addition of bauxite is permitted.

Average Figures Relating to the Melting of High-Grade Tool Steel

Principal Criteria	October, 1958 (Old technique)	November, 1958 (New technique)
Number of melts	49	30
Heats not in accordance with orders, due to high S content	11	1
Satisfied orders, %	77.5	96.6
Average duration, hours, min:		
Heat	8-00	7-54
Melt-down period	2-07	2-19
Working*	2-23	2-04
Sulfur content, %:		
Preliminary analysis	0.039	0.043**
Complete analysis (after melt-down period)	0.033	0.036
Average temperature of metal at commencement of working period, °C	1505	1535
Average basicity of slag after melt-down period	2.2	2.5
Degree of removal of sulfur:		
During melt-down and working periods	68	88
During boil	32	12
During end of melt-down and first half of working periods (before addition of lime)	47	67

*The working period does not include the deoxidation period.

**The higher sulfur content in November is due to the fact that ordinary hot metal was used and the sulfur content after melt-down was high.

The main object in this period is to produce a highly basic, homogeneous, fluid slag and to heat the metal and slag to a temperature ensuring effective desulfurization both at the end of melt-down and in the working period. To speed up the formation of slag in this period, especially if bauxite or lime has been added, the heat input is increased by 10% compared with the input according to the previously operative heating instructions.

After the production of the slag (the temperature of the metal is 1540-1560°C according to immersion thermocouple), the end of the melt-down process is noted, iron ore is added in portions and the slag is carefully removed. The weight of each portion of ore does not exceed 0.8 to 1.0% of the weight of the charge. The external sign of the commencement of the working period can be considered to be the commencement of the boil of the bath and the flushing of slag over the sill of the charging door at the moment of reversing the valves or shutting off the oil nozzle. To prevent oxidation of the slag and over-cooling of the metal, the total amount of iron ore added in the working period should not exceed 1.5% of the weight of the charge.

After careful removal of the slag, a fresh slag is formed by the addition of lime (2%) and bauxite (0.5% of the weight charge). Fluidity of the slag of high basicity in the boil period is regulated by the addition of broken firebrick. In this period, the basicity should be 2.8-3.2 and the CaO content not less than 45%.

The temperature of the metal before tapping the heat should be within the limits 1580-1590°C (before deoxidation 1590-1600°C) as determined by immersion thermocouple. To avoid overheating of the metal, the heat input should be reduced during the boil period, in comparison with that utilized previously.

The table gives comparative figures relating to the melting of high-grade tool steels by the old and new techniques.

In October, 1958, hot metal with a sulfur content not exceeding 0.040% and the purest possible scrap were used for charging. In November, for melting the steel, ordinary iron scrap was used, as well as ordinary pig iron, not specially selected for sulfur content (up to 0.050% S), but desulfurization occurred mainly at the end of the melt-down period and commencement of the working period.

In November, in the case of one heat only, instead of steel U8GA, steel U8 was produced, due to high sulfur content. In this heat, a large amount of magnesia passed from the bottom to the slag, the basicity of which before melt-down dropped to 1.6. It was found impossible to produce an active basic slag and desulfurization conditions at the end of melt-down.

The process of desulfurizqtion of heats according to this technique is characterized by the fact that, at the moment of deoxidation, the sulfur content drops to 0.020%, ensuring the production of carbon tool steel of grade A. In addition, although the melt-down period is increased, the total duration of the heat remains the same, due to the shortening of the working period.

* * *

INGOT SHAPE AND SURFACE DEFECTS

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The shape of an ingot – convexity or concavity of the faces, the magnitude of concavity or convexity, the radius of corner curvature, and other factors, all have a deciding influence on surface defects in steel ingots. As a rule, with the same teeming parameters the number of surface defects increase with an increase in ingot weight. Thus, it was noted that there was an increase in the number of longitudinal cracks in ingots and finished rolled goods when the weight of the ingot was increased from 5 to 6.1 tons.

A five-ton ingot is characterized by the following parameters: an upper size of 670 x 670 mm, a lower size of 550 x 550 mm, an ingot height of 1700 mm, an H : D ratio of 2.79, and a 3.54% taper. The radius of corner curvature is 95 mm at the top and 40 mm at the bottom. The bottom of the ingot is flat, the faces convex.

At first, an ingot weighing 6.1 tons retained the main relationships of a five-ton ingot (H : D, convexity of the faces, radius of corner curvature, shape of the bottom). The weight of the ingot became greater due to its increase in height to 1800 mm, in upper size to 700 mm, and lower size to 590 mm.

Longitudinal cracks were noted when testing this ingot (low-carbon steel). In order to reduce the bottom crop and the number of longitudinal cracks we changed the shape of the 6.1 ton ingot: The faces were made with a 6 mm concavity, the bottom with a 440 mm spherical radius, and the radius of corner curvature was 90 mm at the top and 55 mm at the bottom. As a result of this, the bottom crop of the ingot was reduced from 3 to 1.7% and damage to the ingots by cracks was also reduced.

A further reduction in logitudinal corner cracks in the ingot was attained by decreasing the radius of corner curvature to a magnitude of 0.1 D for the ingot of the given size. With a relationship of $(D_{ingot})/(r_{corner}) = 10$, the maximum thickness of the skin in the corner of the ingot is attained. In this case the least difference in the thickness of the skin in the corner and along the face is ensured. The uniform increase in the thickness of the skin along the corner and face improves resistance to cracking.

When designing ingots with concave faces, the magnitude of concavity should be in agreement with the diameter of the ingot (the ratio of the ingot diameter D to the magnitude of concavity of the face h), and also with the conditions and magnitude of transverse shrinkage of the ingot in the mold.

We tested three types of ingots weighing 6.3 tons with concave faces under plant conditions: The concavity was 15, 20, and 25 mm. The operating ingot has a concavity of 6 mm.

As a measure of ingot surface quality we took the length of the defects on a 190 x 220 bloom. The defects were measured on all sides of the bloom for a length of 3 m (Table 1).

It can be seen from Table 1 that the ingot with face concavity of 15 mm has the greatest resistance to cracking. A further increase in face concavity to 20-25 mm reduces the resistance to cracking because, with the same radius of corner curvature, the corners of the ingot become pointed which causes the formation of internal cracks along the joints of the crystallization zones (here the ratio of D : h is less than 40-35). A sharp ingot corner when the ratio D : h is within 43-29

TABLE 1. Number of Defects on Blooms

Concavity of ingot face, mm	Ratio of D : h	Number of inspected ingots	Brand of steel	corner cracks	Length of defects, m/bloom			
					face cracks	contamin-ations	double skins	total defects
6	115	216	20P, 40Kh, 18-30KhGT	0.07	0.17	0.08	0.04	0.36
15	48	20	The same	–	0.15	0.17	0.02	0.34
20 and 25	36 and 29	63	The same	0.045	0.17	0.16	0.08	0.45

is subject to burning when ingots are heated in a blooming mill soaking pit, especially for steels having low heat conductivity (chromium steels 18-30 KhGT).

An increase in the face concavity to 15-25 mm favors splashing of the metal onto the mold walls, as a consequence of which the ingot surface is contaminated (slag inclusions) and the number of double skins increases.

When comparing the surfaces of ingots weighing 4.1 tons with convex and concave faces (concavity is 6 mm, D : h = 102) it was established that for ingots with concave faces the damage by longitudinal cracks is considerably lower than for ingots with convex faces. Rejection cracks for rolled goods from concave ingots are five times less than for rolled goods from convex ingots, but on the other hand the defect of "burning" on the concave ingot is 8% greater.

An ingot weighing 4.1 tons with concave faces having a greater relative face concavity than an ingot weighing 6.1 tons is somewhat more subject to burning.

As a result of these facts it is possible to conclude that for ingots with concave faces the best ratio is a raratio of D : h equal to approximately 115.

The concave shape in comparison with the convex resists the stresses arising from the forces of ferrostatic pressure and transverse shrinkage of the ingot better since in the first case the skin under the effect of these forces can be displaced toward the walls of the molds to a magnitude equal to the shrinkage of the ingot, which is impossible for the convex shape.

With an increase in the ingot perimeter, but with the same diameter, the amount of heat transmitted by the ingot to the mold increases, which favors producing a thicker skin and improving the crack resistance.

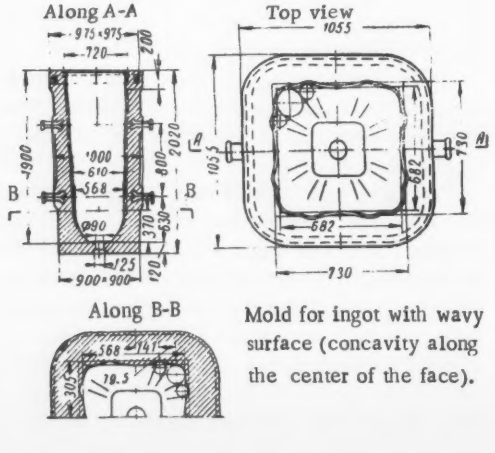
An increase in the perimeter of the ingot is accomplished by changing its flat surface to a wavy surface.

A wavy surface for ingots with convexity along the center of the faces and concavity near the corners can reduce the number of corner cracks, especially for low-carbon steels which tend toward longitudinal cracks. Convexity along the center of the ingot to a certain degree makes it similar to an ingot with convex faces which tends to form longitudinal cracks. The complex shape of the surface causes its contamination and the development of hair cracks. This type of ingot surface reduces the number of transverse cracks and, consequently, also the seams during rolling.

In order to eliminate the longitudinal cracks along the faces we changed the shape of the ingot weighing 6.1 tons: We made the center section of the face concave, the convexity was shifted to the corners, and the corners were placed below the level of the faces (see Fig.). Such an ingot shape is less sensitive to the heating conditions; the absence of projecting corners eliminates their burning and the smooth transition from the corner to the projection located near it makes it possible to shift the corner of the ingot without difficulty during shrinkage.

The projections divide the face into three parts and help eliminate shrinkage stresses in the skin of the ingot, since in each section independent shrinkage forces act whose magnitudes are proportional to the distance between the corresponding projections. In the absence of projections the shrinkage forces are proportional to the length of the entire face, i.e., their magnitude is apparently 2-3 times greater than on a wavy ingot with projections near the corners.

It can be seen from Table 2 that the total number of defects on a wavy ingot for steel of the indicated brands is 1.2 times less than on a common ingot. This ingot is most effective for low-carbon steels for which the number of defects is reduced 1.7 times. The sen-



Mold for ingot with wavy surface (concavity along the center of the face).

TABLE 2. Distribution of Defects on Wavy Ingot

Brand of Steel	Number of heats	Type of ingot	Length of defects, m/bloom							
			Corner cracks	Face cracks	Hair cracks	Contamination	Double skins	Seams	Burning	Total defects
Medium-carbon	18	Wavy	0.04	0.09	0.09	0.019	0.07	0.10	0.78	1.19
		Common	0.09	0.15	0.06	0.06	0.09	0.22	0.92	1.59
18-30KhGT	7	Wavy	0.09	0.06	0.04	0.01	0.06	0.08	0.78	1.12
		Common	0.10	0.10	0.12	0.03	0.10	0.13	0.56	1.14
Chromium	9	Wavy	0.02	0.06	0.05	0.013	0.04	0.026	0.47	0.68
		Common	0.08	0.04	0.10	0.016	0.05	0.044	0.32	0.66
Low-carbon	7	Wavy	0.04	0.17	0.08	0.06	0.04	0.13	0.18	0.70
		Common	0.31	0.16	0.09	0.07	0.09	0.09	0.29	1.10
Total	41	Wavy	0.19	0.38	0.26	0.092	0.21	0.34	2.21	3.69
		Common	0.58	0.45	0.37	0.176	0.33	0.48	2.09	4.49

sitivity of this ingot to burning is somewhat greater than for the common ingot; however, this shape is better than an ingot with a face convexity of 15-25 mm and a wavy ingot with convexity along the center of the face.

Rejects due to surface defects for a wavy ingot with projections near the corners is 0.11% against 0.38% for the common ingot with a 6-mm concave face. The increased tendency to burn for this ingot is due to the deep concavity of the face (at the top 19 mm). In order to eliminate burning it is necessary that the concavity of the face D : h be equal to about 115.

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IMPROVEMENT OF THE MEDIUM WEIGHT KILLED-STEEL INGOT

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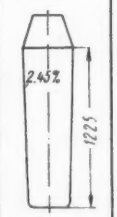
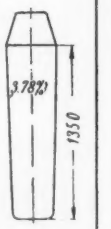
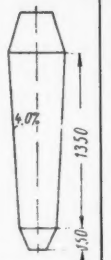
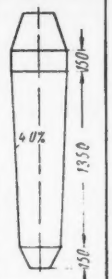
A continuous increase in the charge of open-hearth furnaces and a shortening of smelting time makes it possible to increase steelmaking. However, there simultaneously arises the need to find a way to expedite teeming and rolling of the additionally melted steel. One of the ways is to increase the weight of the ingot. The simplest way to increase the weight of an ingot would be to increase its cross section. However, rolling of such ingots would be difficult because the strength of the billet mill rolls at our plant is inadequate. It is therefore necessary to increase the ingot height also. At the Chusovsk Metallurgical Plant the weight of ingots in the last five years has increased from 1320 to 1650-1700 kg, i.e., by 25%, without an increase in the power of the roughing mill (see Fig.).

Originally, we increased the slope of the ingot faces to 4% on the side, the upper size from 385 x 385 to 400 x x 400 mm, while retaining the former height of the ingot body, and here the weight was decreased from 1410 to 1320 kg.

The use of an ingot with a face slope of 4% made it possible to improve considerably the quality of the rolled spring bands: If the quantity of springs of unsatisfactory quality from samples taken along the entire height of the ingot was 13% then with the new ingot it dropped to 3%. In order to increase the productivity of mill 800 it was necessary to increase the size and weight of the ingot. In spite of the prevailing opinion concerning the harm in increasing the H : D ratio (more than 3)

Ingot profile	1949	1949	1957 - 1958	1959
				
Dimensions, mm	385×385 / 325×325 × 1225	385×385 / 330×330 × 1350	416×416 / 306×306 × 1500	420×420 / 312×312 × 1620
H : D	3.45	3.78	4.1	4.5
Slope of faces on side, %	2.45	2.0	4.0	4.0
Weight, kg	1270	1375	1530	1700

Stages for increasing the ingot weight at the Chusovsk Metallurgical Plant.

we studied at the plant an ingot with a greater value than this magnitude.

As the intermediate stage we introduced an ingot with dimensions of 416 x 416 mm with an ingot body height of 1500 mm and an H : D ratio of 4.18; the weight of the ingot was 1550 kg. Rolling of such ingots did not cause difficulties; the quality of the metal was satisfactory.

Later we studied the possibility of using ingots weighing 1700 kg with a ratio of H : D = 4.5. The quality of the spring bands rolled from such ingots was satisfactory. In addition to this the introduction of a 1700 kg ingot permits us to increase the productivity of mill 800 by 5-7%.

Numerous difficulties were encountered when introducing the ingot with a 4% face slope of increased height. One of these difficulties was the massive welding of the ingots to the molds as a consequence of so-called "burns" forming. In order to avoid this the diffusor-type nozzles were replaced by nozzles with cyclindrical channels and the teeming temperature of the steel was somewhat reduced.

The increase in the ingot height, the organization of self-breaking of ingots by creating artificial bridging, and the use of a diaphragm of thin sheet iron caused some deterioration in the ingot surface quality at the level of the "bridge boom." As a consequence of this the top crop is presently 15% in spite of the satisfactory internal structure of the ingot body (which assures a top crop of 13.5%).

In order to reduce the magnitude of the top crop it is proposed that hot tops of irregular form be used, which assure a better distribution of the metal between the hot top and the ingot body.

It is also planned to conduct experiments for improving the heat-insulation properties of the hot top linings by using porous or light weight refractories.

An increase in the ingot weight for plants with limited roughing facilities is undoubtedly a very effective measure. Thus, under the conditions of the Chusovsk Plant the increase in ingot weight from 1530 to 1650-1700 kg enabled us to increase the productivity of mill 800 by 5-7% and that of mill 370 by 3%, with a total saving of not less than 3 million rubles.

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A REPORT

A. Kulazhenko

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A conference of Ukrainian steelmakers on Bessemer steel production, summoned by the Commission of the State Scientific and Technical Committee of the Council of Ministers of the Ukraine SSR, was held on December 16-17, 1959, at the Krivoi Rog Metallurgical Plant. The conference examined the problems of the

operation of efficient converter mills and the prospects for the future development of this type of steel production.

Representatives of metallurgical plants, scientific-research institutes and design institutes participated in the work of the conference. The conference was led by the Chairman of the Commission of the State Scientific Technical Committee, N. I. Goncharenko, and the Chief Specialist of this Committee, F. F. Ryazanov. Academician I. P. Bardin, Vice President of the Academy of Sciences spoke at the meeting.

The representatives of the plants and institutes gave reports concerning the operation of converter mills in the USSR and on the state of Bessemer steel production abroad.

The conference made recommendations to the plants, scientific-research institutes and design institutes for improving the technological regime of Bessemer smelting, for increasing the resistance of the converter linings, for improving the layout of converter mills and equipment, for introducing automatic regulation and control of the Bessemer process.

ECONOMIC ROLLED-STEEL SECTIONS

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February, 1960

Reducing the weight of buildings and structures, as well as machines, produced by various branches of the machine-building industry is of great significance to the national economy. By using economic sections, it is possible to reduce the weight of machines and structures, to achieve a considerable saving in metal, and to reduce the cost of production.

Light-weight H-beams and channel beams conforming to the new standard differ from ordinary ones by their wider and thinner flanges, thinner webs and flanges, and a more economic distribution of steel among the separate parts of the section, thus resulting in a high bending and compression strength, and a considerably lower weight but the same resisting moment. According to data supplied by consumers, the use of these sections results in up to 20% savings.

The introduction of reduced-weight beams and channels at metallurgical establishments was started in 1955; by 1959, 25 out of 35 types of reduced-weight beams and channels were put into production. Eight sections (beams Nos. 16 and 24 and channels 5, 6.5, 8, 10, 16, 24, 30) are rolled at steel mills in the South and in the East; beams 33, 40, 45, 60, 65, and 70 and channels Nos. 22, 27, 33, 36, and 40 have not yet been introduced; the production of remaining sections has been introduced only in the South or in the East.

By January 1, 1960, the works which are to include the production of beams and channels in accordance with the new standard will discontinue the production of beams and channels conforming to the old standard.

It is important that the production of reduced-weight beams and channels should be introduced at establishments in the South (Makeevka, Enakievo, Petrovskii and "Azovstal'" Works) as well as in the Urals (Nizhne-Tagil and Magnitogorsk Combines) and in Siberia (Kuznetsk Combine). This is essential in order to reduce the long distance transportation of steel sections from one end of the country to another.

In connection with a reduction (in some cases) in the weight of initial billets and some increase in the load during the rolling of reduced-weight beams, the output of the rolling mill in terms of the weight of steel rolled is reduced by 15-30%. Operating conditions during the rolling of these beams result in an over-reduction of the flanges at the rear and front ends of the rolled piece and hence the crop and the specific consumption of steel are increased. However, the output of steel in terms of the length of the rolled sections does not decrease but, on the contrary, increases.

While the output of the mill decreases by 20-25% by weight of steel rolled, the total increase in the cost of one ton of reduced-weight beams constitutes 6-9% according to the data of Nizhne-Tagil and Kuznetsk Combines.

Working-time coefficients during the rolling of reduced-weight H-beams and channels at the section mills of the "Azovstal'" Works and Nizhne-Tagil and Kuznetsk Combines are within the range of 1.11-1.25.

By agreement with consumers, some changes have been introduced in the standard specifications for beams and channels regarding the dimensions and tolerances in the width of the flanges, with the object of improving the rolling conditions and ensuring a high percentage of acceptable product. When the production of reduced-

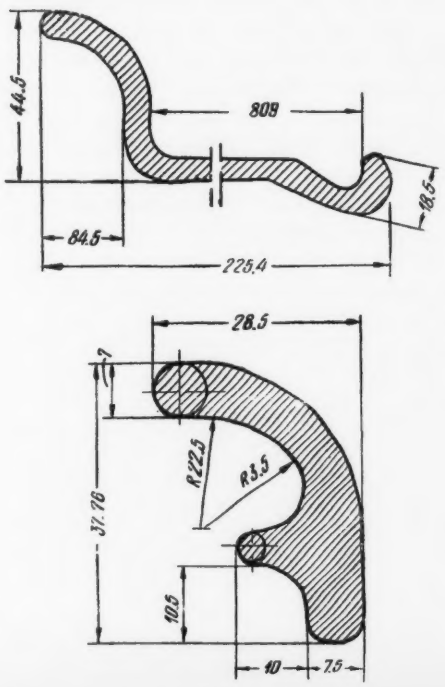

Fig. 1. Reduced-weight sections for car wheels.

weight beams and channels is put into effect, the steel saving should constitute up to 300,000 tons of rolled steel per annum in a total annual production of 1.8-2.0 million tons.

Angles made to the new standard, which includes an increase in the width and a reduction in the thickness of the flanges, are high on the demand list of reduced-weight general-purpose sections.

Angles 35-50 mm wide with the flange thickness reduced to 3 mm can be made only on continuous mills with well designed working stands and equipped with roller-bearings; because of a high speed of rolling the temperature of the steel at the end of the rolling process on these mills is much higher than on mills in train.

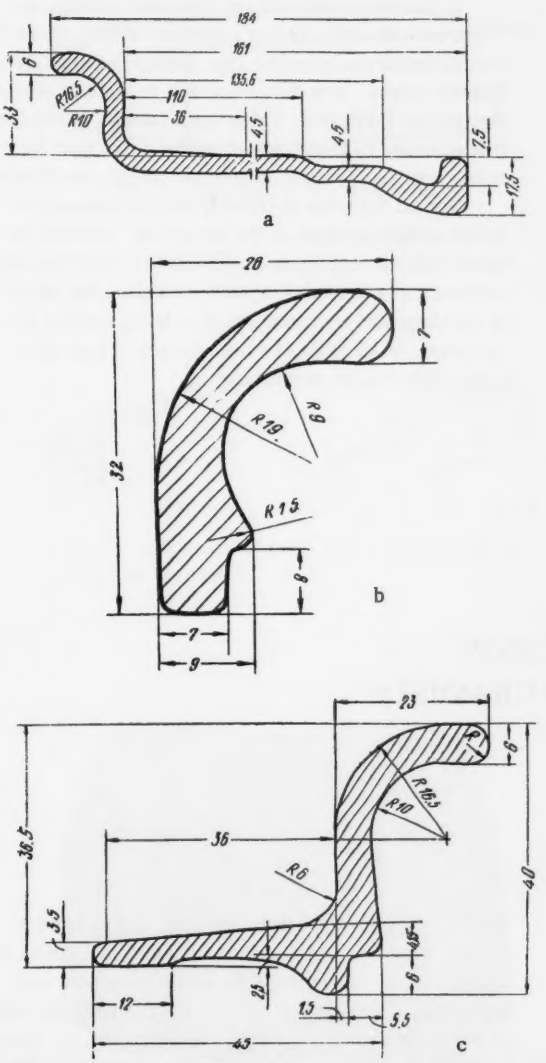

Fig. 2. Reduced-weight sections for car wheel rims (a) and flange rings (b and c).

Continuous mills at the Makeevka, Krivoi Rog and Chelyabinsk Metallurgical Works belong to this class of mill; however, some design defects in the equipment of these mills make the commercial production of thin-wall angles impossible at the present time.

It is essential to eliminate these defects in existing equipment, as well as to design and install additional equipment.

Thin-wall angles, wider than 50 mm, can be rolled on modern continuous and train mills. Of course, the rolling of these sections on some of the mills involves a reduction in output.

The adoption of the production of thin-wall angles with flanges of changed dimensions to conform to the new standard specifications can result in savings of up to 5% of steel.

As early as 1958, reduced-weight angles, 28 x 28 x x 3; 32 x 32 x 3; 50 x 32 x 4; 56 x 36 x 4; 56 x x 56 x 5; 63 x 63 x 5; 90 x 56 x 6; 80 x 50 x 6 mm and others were adopted at the Dzerzhinskii and the Chusovsk Works and at the Magnitogorsk Combine.

With a total production of 1.8-2.0 million tons of angle steel, the introduction of the new standard specifications for reduced-weight angles should result in a saving of 80,000-100,000 tons of steel per year.

Window frame sections produced up to 1958 were found unsuitable for new-design window frames and glass-roof frames. In place of these sections, the Chusovsk Works introduced four new reduced-weight hot-rolled sections with a wall thickness of 3.3 mm instead of 3.8 mm; the production of these sections is to be introduced also at the Komintern Works. The production of frames of the new design will result in a saving of up to 20% of steel and a substantial saving in fuel because of reduced heat losses from buildings.

At present, the Dzerzhinskii, Petrovskii and Chusovsk Works make reduced-weight wheels for the GAZ, ZIL YaAZ and other cars (Fig 1); for GAZ-52 cars a new design of wheel rims with conical flanges and of flange rings, which will be produced at Dzerzhinskii Works, has been developed; the use of these wheel sections should double the service life of tires.

This year the Petrovskii, Chusovsk, Dzerzhinskii and Chelyabinsk Works and the Magnitogorsk Combine are starting the production of reduced-weight wheel rims for ZIL-164, MAZ-200, and Ural ZIS-355M cars;

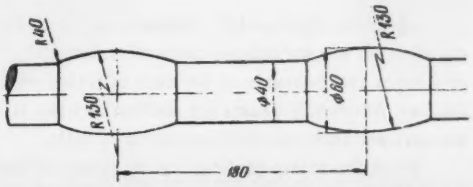

Fig. 3. Circular periodic section for shafts.

flange rings for wheels of MAZ-200, Ural ZIS-355M, and ZIL-164 cars; and locking rings for ZIL-164 car wheels (Fig. 2). These sections are intended for wheels of a new design and also to replace less economic sections which were used previously.

The total demand for the above sections is about 5,000 tons per year; the introduction of these sections will result in a considerable saving of steel, rubber, overhead costs, etc.

By using car springs with parabolic edges instead of rectangular ones, one saves up to 10% of steel. The production of these sections has been introduced at the Stalino and the "Dneprospetsstal'" Works; in connection with the great demand it is envisaged to set up the production of these sections at the Chelyabinsk Metallurgical Works.

In the rail-car industry, a reduction in the weight of cars reduces steel consumption and the operating costs connected with the movement of rolling stock. A reduction in the car weight is now being achieved by introducing light-weight sections made of low-alloy steel (Z-section, H-beam No. 19 for the main beam of rail cars, and others). The number, however, of reduced-weight sections used in the rail -car industry is still inadequate.

The steel industry also produces reduced-weight sections for other branches of the national economy: for the coal industry (steel props for mines, coal conveyors and other conveyors), for the tool industry, for rail transport, etc.

A special group of sections is composed of periodic sections, rolled laterally or longitudinally, the use of which results in a 15-20% saving in steel, a saving in fuel, electric power, labor etc.

The periodic sections which serve as billets for the production of a final part by means of forging, are rolled on the 550 rolling mill, specially adapted for this purpose, at the Petrovskii Works. The same mill is used for rolling sections for the car industry (billets for front axles, axles for side cars, crankshafts, etc.), for the tractor industry (billets for tractor distributing shafts crankshafts and crank axles), for other vehicles, etc. This mill can produce up to 150-200,000 tons of periodic sections per year, but at the moment the production is limited by the demand and constitutes only 30-40 thousand tons per year.

A 120 three-roll mill for transverse rolling, on which one can roll circular periodic sections of 40-120 mm diameter has been put into operation at the Dzerzhinskii Works; now the production of circular periodic sections for shafts (Fig. 3) has been started. In the future, it is intended to install at this Works an 80 mill for rolling circular periodic sections of 20-80 mm diameter.

Not all branches of industry are introducing reduced-weight sections at the same rate; standard designs of rail-car equipment, agricultural, building, road construction and other purposes, as well as the design of buildings and structures are now being revised with the object of an extensive introduction of new hot-rolled light-weight sections.

* * *

SPECIAL FEATURES OF THE PRODUCTION OF REDUCED WEIGHT H-BEAMS AND CHANNELS

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When the light-weight channels and H-beams are rolled there are sometimes cases of nonuniform filling of flanges and fractures at the ends of rolled pieces. A fracture frequently causes the section to wrap around the rolls and results in the breakdown of rolls.

When the rolled piece is cut by shears at the roughing mills the shape of the cross section in the place of cutting becomes distorted. In the place where the cutting begins, the metal is compressed, and where the cutting process is about to be completed, the metal is dragged in the direction of the knife movement and forms fins. As a result of this shear distortion, the end of the billet acquires the shape shown in Fig. 1. Since, in the cutting process the upper edge of the rear end of one billet is sheared from the lower edge of the front end of the next billet, each billet has fins at the top

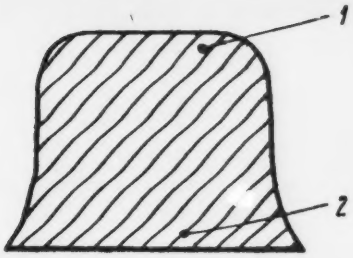

Fig. 1. Shape of the billet end after it has been cut with the shears at the blooming mill: 1) start of cut; 2) end of cut.

Fig. 2. Location of fins on the billet.

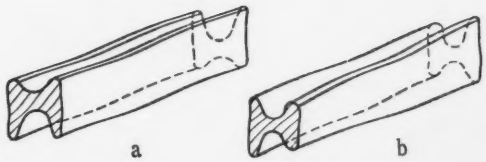

Fig. 3. Shapes of the ends when the piece is cut "flat" or "on edge".

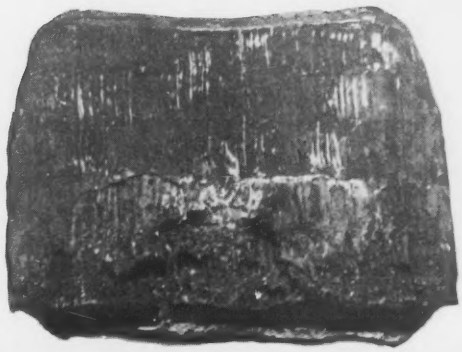

Fig. 4. Disruption of metal at the end of the bloom.

side of the front end, and at the bottom side of the rear end (Fig. 2).

Measurements of a batch of billets of a nominal cross section of 250 x 250 mm showed that at the beginning of the cutting process the end is displaced by 40-70 mm relative to the top horizontal surface of the bloom. The width in that part is reduced by 5-10 mm, and in the place of the fin formation it is increased by 20 mm. In this way, the difference between the width of the top and that of bottom of the bloom constitutes 25-30 mm. Since the metal particles which are subjected to deformation during the cutting are linked with adjoining particles, the deformation (the distortion of the cross section) extends over a length of up to 100 mm along the bloom.

In the course of the deformation of metal during the rolling of H-beams and channels, the following phenomena may occur.

a) When the piece is delivered to the shears on its flat side, that is with its upper front edge parallel to the horizontal axis of the pass, the cut is symmetrical (relative to the vertical axis of the shaping pass); however, there is some underfilling of the upper flanges at one end of the piece, and of the lower flanges at the other end (Fig. 3 a). The edges with the fins ensured a complete filling of the flanges. The over-all underfilling of the base is very small, since a good filling or

Fig. 5. Folds and fractures due to the distorted layers of metal.

even overfilling of the opposite flanges formed from the fins results in a satisfactory over-all width of the flanges;

b) when the piece enters the pass on its edge the cut is nonsymmetric. The flanges formed from the higher portion of the billet are well-filled, but in the compressed portion they are not completely filled (Fig. 3 b).

Depending on the magnitude of the total draft of the steel for a given section (the total draft on the 650 mill is 20-30%), the effect of compression extends over 2-3 m along the piece, which necessitates, depending on the magnitude of the compression, the downgrading of the product because of the too small width of the left or the right flange, or sometimes even the rejection of the piece or an increase in the end crops (this happens only when saws of normal length, i.e., with the range of 6-19 m, are used).

Another undesirable aspect of this cutting is the nonsymmetric position of the web at the end of the piece resulting in the fracture of the web.

The effect of the temperature of the metal on the rolled piece is similar to the effect of the position of the end of the bloom when it is entered into the edging pass, but at the same time the effect of the temperature can extend over the whole length of the billet. In all reheating furnaces at the rolling mills the lower part of the blooms next to the furnace bottom or the skids is at a lower temperature than the upper portion of the bloom.

During the rolling of H-beams and channels the flanges formed from cold layers of metal are not well filled, while hot layers of metal ensure a better filling of the pass. Obviously, in order to obtain left and right flanges of the same width, one should charge the steel into the furnace in such a way that in the subsequent edging pass the cold layers of metal are facing up or down but are never on the side.

During the rolling of reduced-weight flanged sections at the 650 mill it was found that the web was partly fractured at the places where it adjoined the flanges and as a result of this some metal broke off, the grooves were fouled, the guides bent and fractured, and the rolls were wrapped with steel and fractured. Initially it was thought that the web fractures were connected with the quality of the steel and inadequate end cropping at the blooming mill. It was found, however, that fractures occured even on perfectly sound metal, e.g., on blooms taken from the middle of an ingot.

After extensive investigations it was found that the main cause of fractures is an unsatisfactory cutting which causes the deformation of the metal at the ends of the blooms (Fig. 4). During the subsequent rolling, the deformed metal layers forms folds (Fig. 5), and then fractures.

The extent of the deformation depends on the q quality and condition of the knives, on the horizontal distance between the cutting edges of the knives and on the temperature of the steel. Investigations showed that, other conditions being equal, the sharper cutting edges of the knives and the more tight the knives are to each other and the lower the temperature of the steel, the smaller the distortion and damage during the cutting.

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THE ROLLING OF A SPECIAL SECTION NO. 1099

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Number 1099 section for the flange ring of the 20 × 5 mm wheel for trucks has an involved nonsymmetrical shape (Fig. 1). It was produced from high-quality 45 steel on the 250 mill with intermediate reheating according to the original rolling scheme (Fig. 2). A 95 mm square billet, 1.8-1.9 m long, was rolled in 5 passes on the breakdown three-high stand to a square section of 47 mm side, and then the billet was cut into four portions, reheated and rolled in the roughing train consisting of two stands. Only the second stand was used in the production of this section. The rolling operation involved entering the billet into the stand by hand and was carried out in three passes: rectangular oval and square. A thick layer of scale frequently caused slippages. The rolled piece was taken from the roughing train to the finishing train by the transfers which were also intended for turning the piece if necessary, but the length of the rolled piece, limited by the width of the reheating furnace, was smaller than the distance from the roughing train to the transfers and,

therefore, the rolls did not grip the piece. So, the piece had to be moved by hand.

To facilitate the work, the square section was made slightly larger at one end, and therefore if it was entered with the larger end into the first stand of the finishing train, the rear end was underfilled and the section had to be rejected as defective. Rolling of the finishing train was carried out in five passes.

The pass arrangment, which involved an intermediate reheating, had several substantial shortcomings: the use of manual operations on the roughing and finishing trains and at the reheating furnace; a low throughput of the mill (4-5 tons during full-rate production); a considerable cost per ton of finished product; additional production cost on account of the fact that the furnace was used only for a short time and it involved excessive consumption of fuel and a high loss of metal in burning; a poor roll design. The lengths of the rear end of the sections were within the limits of the minus tolerance. In the course of the adjustment of the mill, a deviation from the original scheme toward a greater thickness in the second stand was introduced in order to increase the spread required in the subsequent pass. At the same time the pass in the third was overfilled and this resulted in laps on the finished product.

A new scheme (Fig. 3) for rolling No. 1099 special section with the use of three stands of the finishing train without an intermediate reheating was introduced to increase the output and improve working conditions for

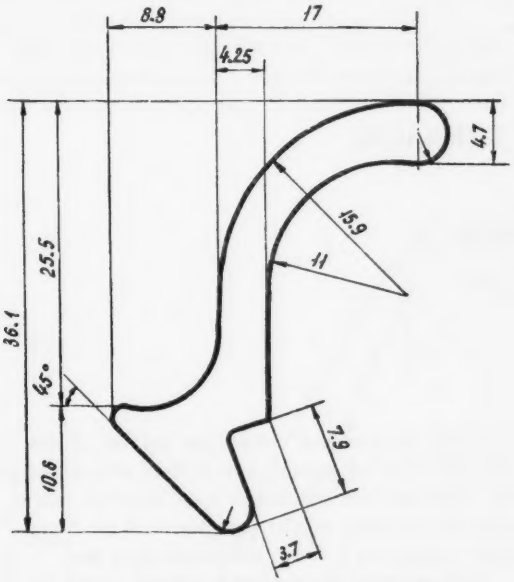

Fig. 1. Cross section of the flange ring.

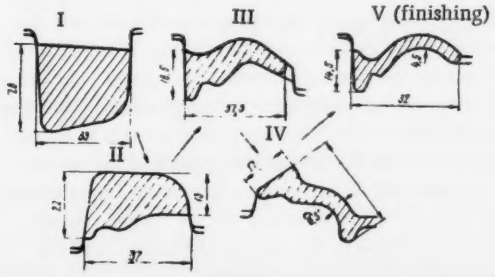

Fig. 2. Original arrangement of passes for rolling the flange ring; I to V) stands.

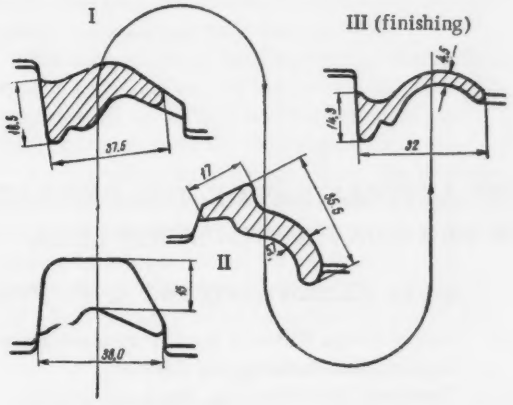

Fig. 3. New arrangement of passes for rolling the flange ring; I to III) stands.

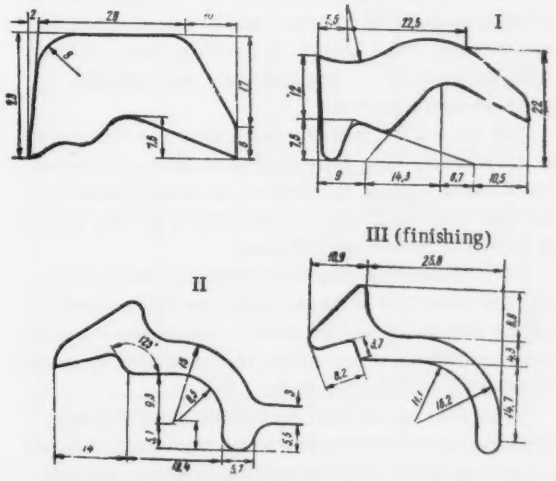

Fig. 4. Pass templets for rolling the special section No. 1099; I to III) stands.

the operating personnel; the pass templets are shown in Fig. 4.

The 95 mm square billet, 2.3-2.4 m long, is cut into three parts after it leaves the breakdown stand. In the first stand of the roughing train, the billet is rolled in two passes (oval and square) to a 28 mm square section. The piece is then taken by the repeater to the shaped pass and then by the transfers to the finishing train. In the shaped passes, except in the finishing stand, one uses flat entry guides which have a satisfactory service life except the rear guide of the second stand, which has to be changed frequently because of surface wear.

Because of rigorous requirements with regard to the external appearance of the finished section, the service life of a pass is short and constitutes35-40 tons in the first and second stands and 10-12 tons in the finishing stand. The rolls have to be changed mainly because of the burning of the surface and the crumbling of the sharp edge on the lower roll of the finishing stand.

The rolls have to conform to rigorous specifications.

The roll diameter is reduced by 3-5 mm in one dressing. A reduction in diameter by more than 30 mm is undesirable since the hardness of the roll is substantially reduced. It is convenient to make the lower rolls of the finishing stand grooved.

By changing to the new scheme of rolling No. 1099 section without intermediate reheating, it was possible to increase the output to 8-9 tons per hour, make three mill operators available for other duties, improve the quality of the rolled section substantially and reduce the cost of production.

* * *

THE AUTOMATION OF THE REHEATING FURNACES OF THE CONTINUOUS STRIP MILL

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The 1450 continuous hot-rolling strip mill at the Magnitogorsk Metallurgical Combine consists of 12 working stands divided into two groups. Three stands of the roughing group (II, III and IV) have vertical rolls to produce sheets of the required width, constant over the length of the strip. Behind the roughing stands and beyond the finishing scalebreaker there are hydraulic sprays for scale removal.

In front of the finishing group there is a flying shear of a crankshaft type for trimming the front end of the rolled piece. Owing to this shear the idling periods of the mill have been reduced considerably and the amount of defective product has decreased.

The rolled pieces from the finishing group of the mill are piled into packs and either cut into uniform lengths with two down-cut shears or are wound into coils by two underfloor roller coilers and transferred by a conveyor to the cold-rolling shop.

The steel for the mill is reheated in three continuous three-zone furnaces into which the steel is charged in two rows at the front end and discharged at the rear end. The furnaces have an active hearth area of 135.5 m^2 and are 5.45 m wide. New construction of a fourth furnace has been started. Mixed gas and fuel oil are used as fuel but the soaking zone is fired with mixed gas only. The heat load reaches 30×10^6 kcal/hr. Air is heated in a ceramic tubular recuperator of the "Stal'proekt" design and is fed to the burners by a fan.

Until recently, the automatic control system for the heating regime of steel in the furnaces of the 1450 mill was not interlinked with the mill operation. The steel was heated in accordance with the technological instructions which specified the temperatures of individual zones of the furnace and the time of heating the steel depending on the various grades of steel and the dimensions of the slabs. Apart from the instruments at the furnace, the quality of steel heating was checked by measuring the temperature of rolled pieces on the roller tables in front of the finishing group, as well as by recording the load on the electric motors of the stands.

An essential factor contributing to an improvement in the quality of steel heating for the rolling process and to an increase in the output of furnaces was the automation of the heating regime.

The standard automatic control system of the heating regime in a continuous furnace comprises the main-

tenance of preset temperatures in each zone of the furnace, the regulation of fuel consumption in each zone, the control of the air-to-fuel ration and the control of pressure in the working space of the furnace.

One of the main shortcomings of the control system is the absence of a feedback pulse from the stand representing the quality of the heating of the steel in the furnace. The preset temperature in separate control zones, as determined by the furnace operator, is basically dependent on the operator's experience. It can happen that the steel is underheated or overheated.

With the object of finding an objective pulse which would represent the quality of steel heating in the furnace, we measured the temperature of the rolled piece after the IInd, IVth, and Xth stands and the load on the motors of the roughing group. Tests were made at various speed of rolling; with each speed of rolling, the above pulses were determined for various heat outputs in the furnace and for various distributions of heat between the upper and lower heating zones.

The temperature after the IInd, Vth and Xth stands was measured by means of a PRK-600 radiation pyrometer, and after the IVth stand by an FÉP photoelectric pyrometer; the load on the motors of the roughing group was measured by a wattmeter and at the same time the instantaneous power required for slab rolling, and not the mean hourly energy consumption (i.e., megawatts and not megawatt-hours) was taken into account.

The determination of all pulses was carried out simultaneously and, therefore, factors connected with the condition of the furnace, the calorific value of the fuel, etc., had no effect on the results obtained from individual measurements.

It was found that of all the pulses studied, the temperature of the rolled piece after the Vth stand (the first stand of the finishing group) provides the most reliable representation of the quality of steel heating in the furnace. Figure 1 shows the temperature after the Vth stand (for a furnace throughput of 50 tons per hour) for various heat loads and various distributions of the heat between the upper and lower heating zones.

The temperature of the rolled piece after the IInd, IVth and Xth stands and the loads of the motors of the roughing group do not represent the quality of steel heating adequately for the following reasons:

1. According to the present system, the temperature of the surface of the slab after the IInd stand is indirectly controlled at the furnace. However, it does not indicate the temperature of the inside of the slab. There were occasions during the investigations when with a high temperature of the rolled piece after the

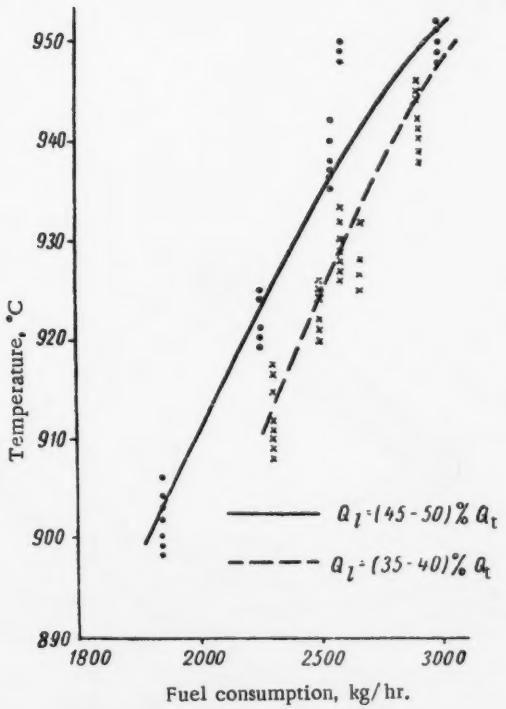

Fig. 1. Dependence of the temperature of the rolled piece after the Vth stand on the heat liberated in the furnace (Q_t is the total quantity of heat liberated in the heating zone; Q_l is the quantity of heat liberated in the lower heating zone).

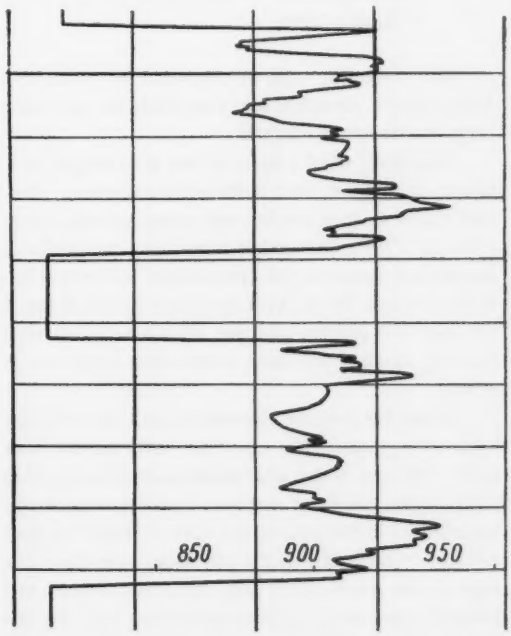

Fig. 2. Diagram of the temperature of the rolled piece after the Vth stand.

IInd stand, the temperature at the end of the rolling process fell down considerably.

2. After the Xth stand the temperature of the sheet depends to a great extent on the speed of rolling, the thickness of the sheet and the quantity of alloying elements, since these factors have a pronounced effect on the "selfheating" of the steel during rolling.

3. There is no hydraulic descaling after the IVth stand and, therefore, one actually measures the temperature of the scale and not that of the metal.

4. The load of the motors depends on several operating variables (the width of the sheet rolled which varies from 630 to 1200 mm, the uniformity of the load of the main drive, the condition of the equipment of the main stand trains, etc.).

When the temperature of the rolled piece is measured after the Vth stand, one obtains information about the temperature of the middle (horizontal) layers of the slab (the total reduction in the stands up to and including the Vth stand constitutes 75-85%). With the existing methods of temperature measurement in the working space of the furnace, this information is important from the operating point of view.

It should be pointed out that the automatic control system of the heating regime of the furnace will receive pulses only from the pieces which pass through the mill without stoppages, i.e., in a definite maximum time period. Any other system will introduce unjustified errors in the heating regime.

Figure 2 shows a temperature diagram of a rolled piece after the Vth stand. Temperature fluctuations due to the pieces which are next to the skids in the furnace can be easily eliminated by means of a filter.

In this way, the temperature of the rolled piece after the Vth stand can be used as a pulse to introduce a correction to the preset temperature in the working space of the furnace if the temperature of the rolled piece deviates from the required value.

From the temperature of the rolled piece after the Vth stand one can determine an optimum distribution of heat between the zones, i.e., one can achieve the required temperature of the rolled piece with the minimum fuel consumption. At the section mills, one can also establish a similar pulse after one of the passes and introduce it into the automatic control system of the furnace heating regime.

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LEVER TONGS FOR THIN STRIP COILS

E. M. Vertoprakhov

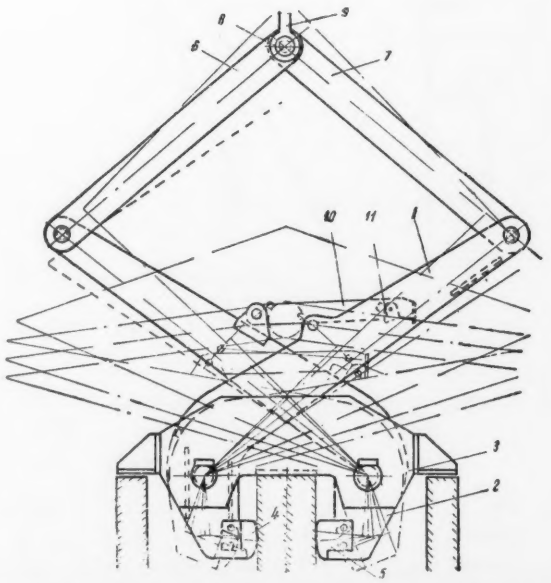
Translated from Metallurg, No. 2, p. 32
February, 1960

For conveying coils of strip steel by cranes at the Magnitogorsk Metallurgical Combine, we used lever tongs shown on the diagram.

The lever tongs consist of two jaws hinged to a cross beam. A gripping shoe is bolted to each jaw. The jaws are hinged to levers which are connected with each other by a pin which passes through an eye in the suspension link attached to the crane hook. A cleat is hinged to the jaw and has a catch by means of which the jaws are kept in a definite position and do not close when they are moved by a crane to the coils which are to be lifted.

When the jaws are lowered to grip the coil, the cross beam rests on the top of the coils and the jaws open. The pin of the jaws slides over the edge of the cleat, opens the catch and goes into the extreme position, i.e., to the stop on the cleat. When the jaws are subsequently lifted, the pin slides over the cleat edge in the reverse direction, deflects the catch and moves further along without interfering with the jaws gripping the coil.

To detach the jaws from the coils when they are brought to their destination, one must continue lowering the tongs until the pin deflects the catch slightly



Lever tongs: 1) and 2) jaws; 3) cross beam; 4) and 5) grip shoes; 6) and 7) levers; 8) pin; 9) suspension link; 10) cleat; 11) catch.

but does not pass behind it, and then the lever tongs can be lifted. During the lifting, the pin enters the notch on the cleat, the jaws are kept in the open position and when the lever tongs are lifted, the coils are left behind. If the pin does not engage in the notch of the plank, one has to lower the jaws slightly again and then lift them.

The jaws, without the coils, are taken by the crane to the next pair of coils. When they are lowered the jaws enter into the coils easily and the cross beam rests on the top of the coils. At the same time the cleat is released. The sequence of operations is then repeated.

The lever tongs can lift two coils at the same time. If necessary, one can lift one coil alone. Two coils can be lifted and carried only if they are close to each other on the conveyor belt.

Several lever tongs of this type are in operation at the Magnitogorsk Metallurgical Combine at present and they have been found quite satisfactory.

ON THE PROBLEM OF THE CENTRALIZATION OF SPARE-PARTS MANUFACTURE FOR EQUIPMENT FOR IRON AND STEEL WORKS

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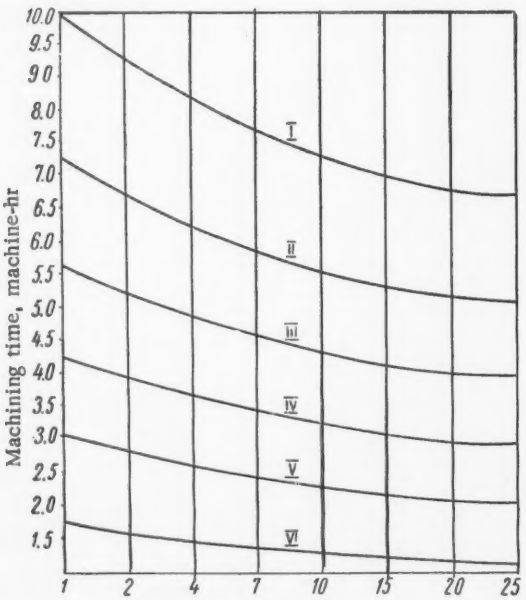
Because of the diversity of equipment in use, the variety in the types of equipment used for the same type of job, and also because of the lack of standardization of parts and machinery, spare parts are manufactured individually or in very small batches. As a result, machine shop equipment as well as working time of the machine operators is not fully utilized and the cost of spare parts is high (see Fig.).

It is seen from the figure that the larger the batch of a frequently manufactured part the smaller the time required for its manufacture (the production time is reduced by 20-25%) because of the reduction in the time required for preparation, finishing and auxiliary operations.



Time required for machining a part depending on the size of the batch: I) screws; II) slides; III) pulleys; IV) bevel pinions; V) nuts; VI) sleeves.

A more rational supply of spare parts for metallurgical establishments calls for extensive work on the standardization of units and parts which will permit the setting up of mass production.

The standardization of the main equipment at metallurgical works requires a considerable period of time. It would be a mistake to postpone the setting up of mass production of units and parts until the work on their standardization is completed. It is known that even now some metallurgical works use parts of the same type. Therefore, it was decided to determine the requirements of metallurgical works of the Dnepropetrovsk National Economic Council with respect to same-type parts for crane equipment, sintering machines and casting machines, taking into account the present state of the standardization at these works.

For this purpose, the crane equipment, and sintering and casting machines of the Dzerzhinskii, Petrovskii, "Krivorozhstal'" and K. Liebknecht Works were studied. At the above works alone, out of 453 cranes, we found 144 cranes of the same type but of different lifting capacity, the largest number being of 5, 10, 15, and 30 ton lifting capacity (Table 1).

The above cranes have units and parts of the same type which permit the setting up of mass production.

The annual demand for these parts is shown in Table 2.

The size of batch of a part of the same type as shown in Table 2 can be substantially increased.

Parts of the same standard dimensions were found only on cranes of the same lifting capacity and of the same make. In the post-war years our factories started the production of standardized cranes with interchangeable units. For instance, the 5-ton cranes made by the "Stal'most" and "Pod'emnik" Works in Moscow and the auxiliary lifting equipment of the 30/5-ton crane made by the Kirov Works have several similar parts. The same applies to cranes of 10-ton and 10/10-ton lifting capacity made by the "Pod'emnik" Works and which have the same gear clutches. Therefore, the batch of

TABLE 1. List of Cranes of the Same Type.

Group	Crane	Lifting capacity, tons	Manufacturer	Quantity
I	Bridge crane	5	"Stal'most" Works, Moscow	44
II	The same	10	"Pod'emnik" Works, Moscow	24
III	The same	10	The same	10
IV	Magnetic bridge crane	10/10	The same	10
V	Bridge crane	15	The same	15
VI	Magnetic bridge crane	30/5	Kirov Works, Leningrad	10

gear clutches for these cranes (group III and IV) will consist of 96 + 70 = 166 clutches. A similar increase in a batch of parts is possible for other standardized cranes.

In addition to the parts listed in Table 2, one can also consider forged hooks for cranes as components of the same type, common to all cranes. A centralized manufacture of hook blanks alone (without machining) would be very effective since it would be possible to make use of die forging.

The number of similar-type cranes is actually much higher than shown in our survey since some other establishments within the National Economic Council have similar cranes.

To establish a complete list of parts of the same type used in crane equipment it is recommended that index cards should be prepared for each standard size part.

The work on finding similar-type parts was carried out with regard to the equipment of sintering plants and casting machines.

A list of parts which are frequently changed and the individual and annual requirements per machine has been established.

When drawings of similar parts from two plants, or even from the same plant, are compared, it is seen that there is a very small difference in the dimensions and the design of these parts. Very frequently, the difference is not fundamental and can be eliminated if the two plants can use the common, most rational design and dimensions.

Thus, for instance, there is a very small difference in the dimensions of rollers and pallets, and in the design of the mounting of the rollers on the axles; the plates for the hydraulic tightening of sintering machines are slightly different in size; the sieves of the stationary screen are slightly different in size; the design of the lining of plate feeders varies; there is also some variation in the weight and arrangement of the hammers in the hammer mills.

There is an even wider variety in the transport systems of various works. Each of the plants has 80-90 conveyors of various widths, lengths, shapes and belt positions. Because the conveyors and spare parts are supplied to the plants by various manufacturers, the driving, stretching and guiding rolls are sometimes cast, sometimes welded, sometimes on roller bearings and sometimes on friction bearings; some conveyors are equipped with screw-type stretching attachments and some with counter-weight attachments. The number of belts of various widths can be reduced and hence the number of various types of unloading cars and conveyor counter-weights can be reduced too; the diversity in the design of bearing assemblies for rollers with grooved or flat roller supports for belts of the same width should also be eliminated.

People who use these parts should, jointly with the manufacturers, establish a rational design for them.

When the change is made to light-weight pig casting on casting machines, the problem of standard molds for old and new machines must be solved to prevent diversity which would occur in the design of these parts if they were to be designed by each work indepen-

TABLE 2. Annual Demand for Parts of the Same Type

Part	Number of parts of the same type in the group						
	I	II	III	IV	V	VI	total
Pinion shaft	88	20	48	10	15	10	191
Headblock friction plate, break disc, break puller	132	20	48	10	30	10	250
Cross sliding coupling	132	10	96	20	30		288
Driving slides for trolley	44	20	144	20	30	20	278
Nondriving slides for trolley	44	20	144	20	30	20	278
Transmission shaft parts	88	30	96	70	90	50	424
Gear Clutch	88	30	96	70	90	50	424
Driving slides for bridge	44	40	96	20	30	20	250
Nondriving slides for bridge	44	40	96	20	30	20	250

TABLE 3. List of Same-type Parts of Sintering Equipment and Steel-casting Machines

Machine	Unit	Part	Annual demand
Sintering machine	Pallet	Flange	1400
		Plate	1890
		Grate	105,000
	Drive	Pinion of the reducing gear train	10
Return screen	Supporting assembly	Driving roller	40
		Back-up roller	30
		Bearing roller	30
D-3500-13 exhaust fan	Rotor assembly	Working wheel	12
		Bearing	12
Swinging feeder	Duct	Protective lining	40
	Drive	Pinion	20
Drum feeder	Drum	Bearings	15
		Detachable pinion	10
Sinter crusher	Crushing roll	Tooth	120 sets
		Cog	120 sets
Plate feeder	Feeder plate	Shell	840
		Lining armor	315
Casting machine with movable rollers	Conveyor belt	Link No. 1	14,208
		Link No. 2	14,208
		Axle	14,208
		Roller	14,208
Casting machine with fixed rollers	Conveyor belt	Link	3080
		Shaft	9240
		Bush	18,480
		Ring	18,480
		Roller	2760
		Axle	2760
		Ring	5520

dently. One should also standardize the assemblies of the drive sprockets and idle sprockets when they are changed to roller bearings.

Even with the present limited standardization of parts of sintering equipment and casting machines it is possible to set up the mass production of a number of standard parts. A list of standard parts is given in Table 3.

The production of standard parts of equipment can be set up at machine shops of individual works and at machine-building works of the National Economic Councils. A study of the utilization of the equipment of the machine shops at metallurgical works shows that some types and groups of machines are not fully utilized because there is not enough work of the particular type available. Centralized production of machine parts for a group of works would permit a better utilization of this type of equipment at one works and it could be made partly or fully available for other duties at other works.

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ON THE PROBLEM OF THE STORAGE OF SPARE PARTS

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Assistant Head of the Section Mill at the Petrovskii Works

Translated from Metallurg, No. 2, pp. 35-36,
February, 1960

"The storage of spare parts of equipment," an article by I. E. Moshkevich, was published in the Metallurgist No. 3, 1959.* We publish here some comments on this article.

The organization of an economic maintenance of basic equipment depends to a great extent on whether there is a stock of spare parts. Therefore, I. E. Moshkevich's article in which he raised a number of urgent problems which face the personnel of the chief engineer's department, the shop assistant heads in charge of equipment and shop mechanics, deserves careful attention.

One must agree with I. E. Moshkevich that work on the determination of standards for spare parts, service life, movement records and storage of spare parts is not carried out thoroughly enough either in industry or at research and educational institutes.

I. E. Moshkevich rightly pointed out that side by side with arranging a systematic storage of spare parts it is also necessary to start work on the standardization of parts with the object of reducing the diversity in equipment types; design sections should prepare card indexes of spare parts at a given works so that the personnel of the design department and of the chief engineer's department could make use of existing patterns during the preparation of drawings for modernization, general overhaul or modification of the equipment. In this way, it will be much easier to prepare the parts at the machine shops since one will require a smaller number of patterns for casting and it will be possible to introduce a number of devices for machining similar parts at the machine shop. First of all, the parts and units of lifting and transport equipment used in all main shops should be considered.

The problem of establishing regional mechanized stores of small- and medium-size parts such as gear clutches, gears, chains, rollers, pulleys, etc., should be considered. For instance, at the Petrovskii Works such a store could be established for a group of rolling shops (rail mill, section mill and plate mill). In this case the minimum stock of spare parts would be 2.5-3 times less than the total sum of the same parts kept in stock at each shop.

We do not agree with Moshkevich's statement that one should first of all keep in stock those parts whose service life is equal or slightly longer than the time required to make these parts locally or to obtain them from a manufacturer. Actually, there are no such parts.

The Petrovskii Works	Name of the machine		Card No.
	Name of the unit		
Shop	Drawing Nos.	Weight of one unit / cost	prepared by / checked by
Place for a 13 x 18 photograph			
Number of the same parts at the shop			
Average service life	Normal stock	Storage place	

Reverse side of the card

Date	I												
Spare units in stock	II												
I													
II													

Why the unit is replaced

No.	Date	Defects of the unit	Signature

It was learnt from experience that the minimum guaranteed stock should consist of parts which have to be changed regularly between major overhauls. This

* See English translation.

category comprises transmission shafts, clutches, gears, pulleys, bushes, bearings, etc. Their number will depend on the number of standard units and on their service life, determined statistically. The remaining parts have to be prepared for major overhauls.

At the rail mill of the Petrovskii Works unit-by-unit repairs are extensively employed. With this method, the time required for repairs is substantially reduced since every unit is assembled beforehand and during the repairs the erection work only is carried out; the spare part stock is also reduced as a result of systemization. While in 1957 it was necessary to keep a stock of spare parts to the value 4.5 million rubles, now this sum has been reduced to 1,786,000 rubles.

With the unit-by-unit repair method, the card index for spare parts is unsuitable because it does not help in establishing whether a part which is essential for successful repairs is in stock.

A card index for separate units is a more practical proposition. Then, the mechanic, the equipment engineer and the personnel of the chief engineer's department do not have to keep a record of a large variety of parts. Therefore, the shops can easily prepare their orders, and the chief engineer's department can easily check the actual requirements of spare parts for each shop.

The index card used at the rail mill of the Petrovskii Works is shown here.

As regards the reconditioning of worn parts at metallurgical works, it is advisable not to machine (regrinding, dressing etc.) the parts down to smaller dimensions but to restore them to their original dimensions by building them up by means of welding using the method of the E.O. Paton Institute. This method is used for reconditioning crane slides, roll barrels, axle necks and many other parts at the Petrovskii Works.

THE DEVELOPMENT OF THE ROLLING INDUSTRY IN THE CHINESE PEOPLE'S REPUBLIC

I. G. Bukhvostov and Huang Ssŭ-ts'ang

Translated from Metallurg, No. 2, pp. 37-40,
February, 1960

The Chinese People's Republic has inherited from the old semifeudal China an extraordinarily ill-developed metallurgical industry; the rolling industry was one of its weakest branches. Up to 1949 in China there were a small number of obsolete rolling mills at Anshan, Shanghai, Chungking, Tai and in a few other places, producing limited quantities of strip steel of medium and small sections. At this time the maximum rolling production was in all 686,000 tons. In 1949 only 123,400 tons of rolled products were manufactured. In the old China they produced no heavy-duty rails at all, no large girders, no rolled sections of high-grade steel, no electric sheet or other types of rolled product.

The rapid tempo is the distinctive feature of the growth of rolling production in the CPR. Figures for the growth of rolling production from 1952 to 1958 are shown in Table 1.

Thus, in six years, rolling production in the CPR has increased by a factor of 5.5, the average yearly growth rate being 32.8%. The liberated Chinese people in the period of restoring the national economy and implementing the first Five-year Plan for the growth of the national economy built a number of modern rolling plants, which include a blooming-slabbing mill (roll diameter 1150 mm) with a capacity greater than 3 million tons per year, rail-structural mill (roll diameter 800 mm) with complex auxiliary equipment for treating heavy-duty rails and large shaped sections, a shop for producing seamless tubing up to 165 mm in diameter, shops for producing high-grade and sheet steel. Existing rolling mills were also expanded and modernized in the first Five-year Plan.

The construction of new and the modernization of existing factories made it possible even in the first Five-year Plan to organize the production of finished rolled products from billets obtained from larger ingots. In the CPR at the end of the first Five-year Plan 5000 section-sec (together with semifinished products) were rolled: In this number is included heavy-duty rails, large beams up to 45 gauge, channels of all dimensions, seamless tubes, electric sheet, steel sections from high-grade and alloy steels, and also plate and sheet from plain-carbon and alloyed metal.

The implementation of the second Five-year Plan for the development of the national economy placed before the workers in the rolling mills of the CPR even greater problems connected with the increase in production to satisfy the country's need in various types of rolling production in the best possible manner.

On the basis of the scheme worked out by the Central Committee of the Chinese Communist Party, to establish socialism with the slogan "bigger, quicker, better, more economically," Chinese metallurgists are developing rolling production, like all ferrous metallurgy, by combining the creation of large-scale highly mechanized and automated rolling factories with the construction of medium and small rolling factories with little mechanization of production processes.

The Anshan Metallurgical Combine forms the first operative metallurgical center, an achievement forged by the workers and technicians of the CPR; the second and third centers in the country are metallurgical combines being constructed at Wuhan and Paotow, at which first-class rolling factories will be set up.

The chief medium and small capacity rolling industry is being established in Shanghai.

At present in the CPR, blooming mills with roll diameters of 825 and 1150 mm have been set up and are working successfully: These are continuous billet mills, one of which contains stands with vertical rolls (all stands are driven from direct-current electric motors at a regulated speed of revolution of the rolls). In their technical features they surpass analogous mills in the USA. One also should note a semicontinuous sheet mill producing a wide variety of plate and sheet, a rail-structural mill of roll diameter 800 mm, whose production capacity has been almost doubled, a seamless tube mill with complex auxiliary equipment and other mills. The following high efficiency mills are under construction – a blooming-slabbing mill, roll diameter 1150 mm; a continuous small section mill consisting of 15 stands, on which it will be possible to roll circular and square-section steel 10-35 mm in dimension, 8 kg rails, strip and other sections; a four-strand continuous rod mill, roll diameter 250 mm, consisting of 39 stands for rolling wire rod 5.5-10 mm in diameter in a fully mechanized

TABLE 1. Growth of Rolling Production in the CPR from 1952 to 1958

Year	% of 1952 production level	% increase in the year	Remarks
1952	100	–	End of the period of restoration
1953	134	34	First year of implementing the first Five-year Plan
1954	159.3	13.8	
1955	200.3	25.7	
1956	290.0	44.8	
1957	386.5	33.3	Last year of implementing the first Five-year Plan
1958	549.4	42.1	First year of implementing the second Five-year Plan

and automated process with a rolling speed of up to 28 m/sec; and a number of thin-sheet mills for producing cold-rolled sheet.

In tube production in the CPR experience is being gained on plants that are being set up for electric-welding tubes 20-650 mm in diameter, with complex equipment for finishing and testing them.

Side by side with the most modern rolling mills, a large number of less mechanized rolling mills of medium or small production capacity are either working or under construction in the CPR; these are playing and will play an important role in supplying the national economy with rolled products until the rolling industry is fully reestablished on a contemporary basis.

The following are the most characteristic of this type of mill:

1. For rolling ingots weighing 1.8-2 tons down to blooms 150 x 150 mm and 170 x 170 mm in section, single-stand blooming mill (roll diameter 700 mm), to which are set up two 3-high stands (roll diameter 500 mm) for rolling the blooms into semifinished sections 80 x 80 and 60 x 60 mm in cross section suitable for the small section or rod mill.

2. For rolling ingots weighing up to 3 tons into billets or large sections from a single reheat, large section mills (roll diameter 900 and 800 mm) consisting of a reversing stand with controlled roll speed and three stands (roll diameter 800 mm) in one line.

3. For rolling ingots weighing 600 kg into billets or finished sections, large section mills consisting of three stands (roll diameter 650 mm) driven by a 2300 kw ac electric motor.

4. For producing small sections, mills (roll diameters 500 and 300 mm) consisting of seven stands arranged in two lines, and also two-line mills (roll diameters 400 and 250 mm) of six stands.

5. For producing steel plate, single-stand three-high mills (roll diameters 750, 500, 750 mm) with roll width 2300 mm and complex equipment for heating the ingots or slabs, moving them and cutting the metal.

6. For producing hot-rolled sheet steel by the pack method, two-high mills (roll diameters 650-760 mm) with roll widths of 950, 1100, and 1200 mm; the most frequently encountered mills (roll width 1200) consist of two, four and six stands, each pair of stands being powered through a gear-train from a separate electric motor of 1000 kw power.

7. For producing seamless tubes, tube mills with little mechanization consisting of a piercing mill and two stands for the final shaping of the tubes.

On existing mills, Chinese rolling personnel have carried out a series of modifications which considerably increase the production capacity of the mills. By this means alone, in 1958 the production of rolled products in the CPR increased by more than a million tons.

The following should be noted among the most significant modifications made in existing rolling factories in 1957-1959.

Blooming Mills. 1. In order to increase the productivity of the soaking pit section in blooming mills (roll diameters 1150 mm and 1100 mm), additional groups of recuperatory and regenerative soaking pits have been installed, the tempeature of ingots while soaking in the pits has been increased, and removal of liquid slag is carried out from both the regenerative and recuperatory soaking pits. It should be noted that liquid slag removal from recuperatory soaking pits and heating the lower parts of the ingots by installing four additional burners in the lower wall section of each pit gave improved results. The production capacity of groups working with liquid slag removal and with bottom heating was increased by 10-12%.

2. On a blooming mill (roll diameter 1100 mm) a single main-drive electric motor of 5500 hp was replaced by two, each roll being driven separately by an electric motor of 3500 hp at 0, 40, 60, 80 or 100 rpm. This made it possible to increase the production capacity of the mill by 500,000 tons of finished product per year.

3. The ingot weight used on a blooming mill (roll diameter 1100 mm) was increased from 5.6 to 8.3 tons.

4. The exit cross sections of blooms from blooming mills (roll diameters 1150 and 1100 mm) were increased: on the 1150 mm blooming mill, from 300 x 300 mm to 350 x 350 mm; on the 1100 mm blooming mill, from 240 x 240 mm to 280 x 300 mm.

5. In 1958, rolling two ingots simultaneously was undertaken in the 1150 mm blooming mill.

Continuous Billet Mills. The increase in production capacity of this group was achieved basically by increasing the entering and exit cross sections of blooms and billets. Thus, on a 12-stand mill with vertical rolls, the cross section of incoming blooms was increased from 300 x 300 mm to 350 x 350 mm; in a continuous billet mill (roll diameter 600 mm) the cross section of incoming billets was increased from 195 x 195 mm to 240 x x 240 mm; moreover, for turning the material between stands tilting rolls have been installed instead of helicoidal guides. This has shortened the throughput by 20-30 min and has improved the surface finish of the billets being rolled.

Section Mills. The largest number of technical modifications has been carried out on section mills, which produce the chief part of the commodity production.

1. In a number of factories the capacity of reheating equipment has been increased by installing new heating furnaces. At the moment, in certain factories a number of furnaces have been constructed to work on blast-furnace gas, and are being brought into production. In one concern a four-zone continuous furnace for reheating ingots weighing up to 1 ton is working. In Shanghai, an experimental reheating furnace of original design has been constructed and is working: The billets being heated are arranged in two layers in the furnace. This furnace is charged at one end; the upper layer of billets is discharged at the front, and the lower at the side. The furnace is coal-fired. The upper tier is 16.5 m, and the lower tier 12.3 m long; the width of the furnace is 2.0 m, and the production capacity 27 tons/ /hour.

2. Work was carried out in 1958-1959 to replace main-drive electric motors by ones of greater power and higher speed.

3. In all types of section mills, a method of rolling using more than one work-piece has gained wide application (this is rolling with overlapping – a number of billets are rolled simultaneously in the finishing stand).

Heavy-duty rails are rolled with three to four work-pieces passing simultaneously through the stand; beams and channels, two to three work-pieces; and small section rounds, three to four or more work-pieces. Rolling medium and small section steel to two or three finished sizes simultaneously is carried out; hot-rolled wire rod is chiefly rolled in four strands.

In Factory No. 2 at Shanghai, and at the Shenyan metallurgical factory, they are considering scheduling the rolling of wire rod simultaneously in six strands on the finishing line of a semicontinuous mill.

4. One of the most important measures for increasing the productivity of existing looping mills is the introduction of rolling in two streams, which is realized by creating two streams of metal of the same or differing profiles by: a) removal of part of the metal in billet form by cutting from the roughing stand (thus, the section being rolled in the mill is delivered from the finishing stand); in this case rolling is carried out "through one", that is, the rolling of one work-piece is completed in the first stand, the rolling of the second is completed in the finishing stand, of the third, in the first stand, of the fourth, in the finishing stand, and so on; b) partial reconstruction of factories and the installation of additional equipment, which makes it possible to roll differing profiles in two streams in a system of stands set out in two lines.

With the first method at the Taiyan Combine billets are rolled in the first stand and in the finishing stand. Using the second method they are working a small section mill (roll diameter 500-360 mm) in No. 3 factory in Shanghai, and a small section mill (roll diameter 400-250 mm) in the Tangshan Metallurgical Plant. The annual production capacity with two-stream rolling has been increased in a mill with roll diameter 500 and 360 mm, depending on the section being rolled, by up to 1.4 times, and in mills with roll diameter 400 and 250 mm by 1.5 times.

5. In all section mills work has been carried out and is going on to improve the groove design of working rolls by reducing the number of passes and by correctly alloting them to the stands. For example, in a rail structural mill the number of passes in rolling rails was reduced from 11 to 9. The method is being applied to the design of grooves for beams in inclined grooves, channels with undulating webs and so on.

6. To increase the production capacity of small section and wire-rod mills, and also to improve the quality of round sections, a tandem arrangement is being used of two finishing stands working as a continuous group. In particular, this measure has been introduced in the looping wire-rod mill of Factory No. 10 in Shanghai, where they have set up behind the finishing stand an additional two-high stand, the drive for both stands being from the same electric motor through multiple V-belt transmission. This made it possible to achieve the direct conversion of a work-piece of oval cross section into the finished round, the oval being tilted in a tube through 90° without the use of guiding apparatus. It was possible to eliminate interruptions in rolling caused by the work-piece jamming in passes during the transfer of the oval, by means of the guide apparatus, into the final round with a diameter of 6-8 mm.

TABLE 2. Working Details of Certain Section Mills of the CPR

Mill	Brief technical description	Total production, thousands of tons			Production capacity per actual working hour, tons/hour			Time working, %			Remarks
		1957	1958	6 mo. 1959	1957	1958	6 mo., 1959	1957	1958	6 mo. 1959	
Rail-beam 800*	Three stands in line	730.0	892.4	436.0	132.4	149.2	142.9	63.5	63.0	70.0	For rolling rails, beams, channels, angles
Large section 650*	Three stands in line	176.4	220	126.0	26.8	29.9	35.0	84.2	84.5	82.7	For rolling billets, sheet-bar, light rails, angles, beams
Medium section 580*	Four stands powered from two electric motors	480	540.1	284.7	79.7	84.2	92.1	71.4	73.4	74.0	For rolling beams, channels, light rails, strip
Small section 500/360*	Two lines: first line – 2 stands 500* second line – 4 stands 360*	184.6	320.7	161.7	27.1	45.2	44.8	77.8	81.1	83.2	For rolling billet for 8 kg rails, No. 6, 5 and 9 channel, 75 x x 75 mm angle. Since 1958 it has been working in two streams
Small section 330*	Two lines 435/330* consisting of 2/0 stands	–	237.7	128.7	–	32.4	34.6	–	84.4	85.7	Rounds 9-32 mm in diameter and intermittent sections up to 30 mm
Small section 400/250*	Three lines, two strand-working: 1st line – 2 stands 400;* 2nd line – 6 stands 250;* 3rd line – 4 stands 250;*	113.4	115.0	79.0	14.6	16.5	22.6	89.3	85.5	80.6	For rolling rounds 16-22 mm in diameter, work in as two streams from the second half of 1958

*These figures refer to the roll diameters in mm.

TABLE 3. Data of Sheet Mill Working in the CPR

Mill	Total production, thousands of tons per year		Production capacity, per actual working hour, tons/hour		Time working, %	
	1958	6 months 1959	1958	6 months 1959	1958	6 months 1959
Mill A	82.9	57.2	2.78	3.77	75.70	—
Mill B	95.2	46.3	3.36	3.42	80.74	78.0
Mill C	33.8	24.3	2.53	2.98	83.6	—

7. With the object of improving the shape of the finished profile of hot-rolled wire coils, two pairs of vertical rolls belt-driven from the horizontal rolls have been installed in the wire-rod mill of the "Sinhu" factory, after the finishing stand. By imparting a small reduction to the work-piece with the vertical rolls it is possible to obtain the exact profile of the round wire.

8. Guiding apparatus (repeaters) are being successfully worked on existing small section mills in Shanghai and other factories. In Shanghai they are rolling steel rounds, strip and angles with the use of this apparatus. One mill (roll diameter 280 mm) in Severo-Vostok is working with the use of guiding apparatus and roller fixtures.

In Table 2, working details of certain section mills are presented.

Sheet Mills. At present a considerable part of the steel sheet in the CPR is being produced on two-high sheet mills. The chief measures which have been carried out on these mills are: a) the introduction of conveyor furnaces for heating the sheet-billet and packs; b) the development of rolling four sheet-billets simultaneously; c) rolling sheet-billets and packs simultaneously in the same stand; d) mechanization of the rolling process by the method of installing two-tier tables to the design of engineer T'ang Fu-ling, installing ground-level doublers and other mechanical devices.

Figures for the working of three sheet mills are shown in Table 3.

By implementing a broad program of rolling-mill construction, the Chinese metallurgists have introduced much that is new and interesting, and this indicates that the technical level of Chinese machine engineers and rolling technologists is rising considerably. Suffice it to say that at present in the CPR they are preparing by their own efforts a blooming mill (roll diameter 1150 mm), a large section mill (roll diameter 850-650 mm), and are designing, and in the near future will have constructed, a number of rail-structural mills. From the second half of 1958 and in the following year, the method of treating large details of rolling mills by the method of "an ant gnawing at a bone" has gained wide application: this is, by means of small mills with the use of every kind of gadget, devised by the workers, engineers and technicians.

The exploitation of the new rolling mills that have been built has required the training of an enormous number of new personnel, basically of young people, who have come from the towns and countryside of China to study in the rolling plants at the Anshan, Taiyan and Chungking combines and other factories.

By the development of the iron and steel industry at a tempo unparalleled in the capitalist countries, the Chinese people have written one of the most brilliant chapters in the history of the establishment of socialism in the Chinese People's Republic.

A Book about Metallurgists

Reviewed by V. Ukrainskii.

The start of work in the Petrovskii (now the Enakievo) factory dates from the year 1862. However, the first melts were failures, and in 1868 the factory was closed. It was opened again only in 1897. Despite this, the Enakievo works is considered from the date of its founding to be the oldest in the Donets Basin.

The publishing house of the Stalino Province has issued a book entitled "The Glorious Path," devoted to the past, the present and future of the Enakievo works.

The material in this book has been prepared by members of a literary society attached to the editorial staff of the newspaper "Enakievo Worker" and is of considerable interest to our metallurgists.

In the section "Undying fires," the Donets journalists B. Borovik and I. Arutyunov tell, from the history of the factory, of the inhuman exploitation which the workers suffered at the hands of Russian and foreign capitalists of the "Russo-Belgian Metallurgical Company." In the years 1911 to 1921 alone, the shareholders of this company received 4,704,151 rubles in net profit. But in this period, as is reported in an official document presented by the authors of this section, the death-rate among the workers from malnutrition and accidents increased. In 1910, a catastrophe occurred in the blast-furnace plant because of the absence of elementary safety precautions; molten pig iron escaped under the hearth, as a result of which a number of men perished.

A large part of this section is devoted to the revolutionary struggle of the Enakievo metal workers and their participation in the events of 1905 and 1917.

In the book there is featured "Notes from a Diary," the diary of a former blast-furnace plant manager, Ivan Pavlovich Bardin, in which he recalls his collaboration in 1915 with the eminent Russian blast-furnace technologist, Mikhail Konstantinovich Kurako.

Ivan Pavlovich has given Enakievo metallurgists much valuable advice for improving production methods; he courageously recommended the use of a converter, modified for blowing the metal with pure oxygen from above.

A. Minaev, the director of the Enakievo metallurgical plant, describes in the book's pages the contemporary day of the Enakievo metal worker. Tasks, which formerly were done by hand, are now performed by new Russian machines. After reconstruction, rolling in a 280 mm roll diameter mill was organized in two strands. Today the collective on this equipment has doubled the country's highest production record for mills of this type.

The metal workers of Enakievo lead a happy life. Today more than 200 engineers and 700 technicains work at the factory, whereas until the revolution there were only a few of them. More than 4000 metal workers are studying courses in evening and correspondence classes, technical schools and institutes, and in young workers' evening schools.

Photographs illustrating the growth of the factory are shown in the book, and there are verses by local poets dedicated to the heroic labor of the metal workers.

The Stalino publishing house has performed a good and useful action in issuing this book.

Let us hope that similar books will also be published about other undertakings in the iron and steel industry.

N. P. Lyubin and V. V. Trofimov. Quality of Rails, Metallurgizdat, Khar'kov, 1959, 203 pages.

In this book fundamental data are presented about the production of railroad rails: methods of producing steel for rails; rolling in blooming and rail-structural mills; heat treatment; finishing; and quality control.

Separate chapters of the book are devoted to internal and external defects in rails, and to inaccuracies of profile.

Much attention is paid to methods of testing rails for tensile strength, hardness, strength of the underside, impact resistance, fatigue strength, etc., and also to properties in service.

The book is intended for engineer-technical workers in metallurgical factories and for workers engaged in methods of application, and may also be useful to students of higher educational institutions specializing in the production and application of rails.

S. S.

V. A. Goncharenko, N. V. Rozenfel'd. Advanced Methods in Rolling Tubes in Installations with an Automatic Mill. Metallurgizdat, Moscow, 1959, 119 pages.

In this book, use is made of material of an interfactory study group for the pioneer test and the working test in the Zakavkazsk metallurgical factory in rolling tubes in automatic tube-rolling installations. A description is given of the installations working in the Rustav', Sumgait, Nikopol', Pervouralsk, and other factories; the advanced working methods on the piercing, automatic and rolling mills are summarized.

In the book the material of the interfactory study group on roll-changing, adjustment of the piercing mill, its working rhythm with automatic equipment is ex-

amined in detail. The pioneer working test of the mill operators and foremen is described.

Much attention is paid in the book to technical improvements on mills: installation of apparatus for alignment, preparation in the hot condition, steadying mechanism, mechanism for tilting tubes, changing mandrels, etc.

Moreover, a test on rolling tubes of larger diameter, including thick-walled tubes, is examined.

The book is intended for workers and foremen in tube-rolling plants.

S. S.

SIGNIFICANCE OF ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN SOVIET PERIODICALS

FIAN	Phys. Inst. Acad. Sci. USSR.
GDI	Water Power Inst.
GITI	State Sci.-Tech. Press
GITTL	State Tech. and Theor. Lit. Press
GONTI	State United Sci.-Tech. Press
Gosénergoizdat	State Power Engr. Press
Goskhimizdat	State Chem. Press
GOST	All-Union State Standard
GTTI	State Tech. and Theor. Lit. Press
IL	Foreign Lit. Press
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd. AN SSSR	Acad. Sci. USSR Press
Izd. MGU	Moscow State Univ. Press
LÉIIZhT	Leningrad Power Inst. of Railroad Engineering
LÉT	Leningrad Elec. Engr. School
LÉTI	Leningrad Electrotechnical Inst.
LÉTIIZhT	Leningrad Electrical Engineering Research Inst. of Railroad Engr.
Mashgiz	State Sci.-Tech. Press for Machine Construction Lit.
MÉP	Ministry of Electrotechnical Industry
MÉS	Ministry of Electrical Power Plants
MÉSÉP	Ministry of Electrical Power Plants and the Electrical Industry
MGU	Moscow State Univ.
MKhTi	Moscow Inst. Chem. Tech.
MOPI	Moscow Regional Pedagogical Inst.
MSP	Ministry of Industrial Construction
NIIZVUKSZAPIOI	Scientific Research Inst. of Sound Recording
NIKFI	Sci. Inst. of Modern Motion Picture Photography
ONTI	United Sci.-Tech. Press
OTI	Division of Technical Information
OTN	Div. Tech. Sci.
Stroiizdat	Construction Press
TOÉ	Association of Power Engineers
TsKTI	Central Research Inst. for Boilers and Turbines
TsNIÉL	Central Scientific Research Elec. Engr. Lab.
TsNIÉL-MÉS	Central Scientific Research Elec. Engr. Lab.-Ministry of Electric Power Plants
TsVTI	Central Office of Economic Information
UF	Ural Branch
VIÉSKh	All-Union Inst. of Rural Elec. Power Stations
VNIIM	All-Union Scientific Research Inst. of Meteorology
VNIIZhDT	All-Union Scientific Research Inst. of Railroad Engineering
VTI	All-Union Thermotech. Inst.
VZÉI	All-Union Power Correspondence Inst.

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us – Publisher.